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USCG OILY WATER SEPARATOR SYSTEM
CARTRIDGE USAGE DATA SURVEY

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FINAL REPORT

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16. Abstract Eighty U.S. Coast Guard cutters with Oily Water Separator Systems installed were surveyed. These cutters range in size from 65 foot river buoy tenders to 378 foot high endurance cutters. Filter-coalescer cartridge usage rate and cost data was obtained. Commencing with the installation of the first prototype oily water separator in September 1973, approximately 10,283,260 gallons of effluent have been processed, at a cost of \$33,967.73 for cartridges. Installation costs for these systems totalled \$1.368 million. Overall cost/gallon of effluent processed to date is 0.3497 cents; 100 GPM OWS cost is 0.2371 cents/gallon; 10 GPM OWS cost is 0.7537 cents/gallon and the 5 GPM OWS cost is 1.2378 cents/gallon. (These figures represent only the cost of cartridges and do not reflect maintenance, installation or repair costs to the OWS systems). Projected installation costs for all 261 active U. S. Coast Guard vessels is \$3.5 million, and the projected annual cartridge cost for operating the 261 systems is \$156,129. (Based on present cartridge prices and available data). The projected annual cartridge cost to equip the 125 confirmed OWS systems for the coming year is \$69,085.00.		
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ABBREVIATIONS

OWS	- Oily Water Separator
GPM	- Gallons Per Minute
PPM	- Parts Per Million
K	- Thousand
GAL	- Gallon
ΔP	- Change in Pressure (pressure differential)
SICP	- Ship Inventory Control Point
QA	- Quality Assurance
NAVSEC	- Naval Ship Engineering Center
G-ENE	- Coast Guard Naval Engineering Division
G-DET	- Coast Guard Research and Development (Environmental and Transportation Technology Division)

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol When You Know Multiply by To Find Symbol

LENGTH

in	inches	2.5	cm
ft	feet	30	cm
yd	yards	0.9	m
mi	miles	1.6	km

AREA

in ²	square inches	6.5	cm ²
ft ²	square feet	0.09	m ²
yd ²	square yards	0.8	m ²
mi ²	square miles	2.6	km ²
	acres	0.4	ha

MASS (weight)

oz	ounces	28	g
lb	pounds	0.45	kg
	short tons (2000 lb)	0.9	t

VOLUME

tblsp	tablespoons	5	ml
fl oz	fluid ounces	30	ml
c	cups	0.24	l
pt	pints	0.47	l
qt	quarts	0.95	l
gal	gallons	3.8	l
ft ³	cubic feet	0.03	m ³
yd ³	cubic yards	0.76	m ³

TEMPERATURE (exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	°C	Celsius temperature
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Approximate Conversions from Metric Measures

Symbol When You Know Multiply by To Find Symbol

LENGTH

mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi

AREA

cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10,000 m ²)	2.5	acres	

MASS (weight)

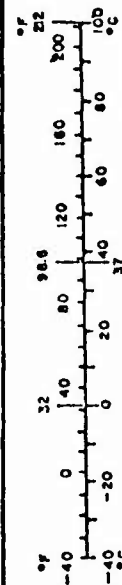
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	

VOLUME

ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³

TEMPERATURE (exact)

°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F
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* 1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Mon. Publ. 286, Units of Weights and Measures, Price \$2.25, SO Catalog No. C13.10.286.

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1.0 INTRODUCTION

In response to a request from Commander, Naval Sea Systems Command, the Coast Guard Naval Engineering Division and Research and Development Office initiated a fleetwide survey of U. S. C. G. vessels to obtain performance and cost related data on oily water separator systems. The purpose of this request was to examine the suitability of utilizing filter/coalescer type oily water separators on U. S. Navy vessels by acquiring installation, operation, maintenance and logistics support requirements of similar systems on U. S. C. G. ships.

The U. S. C. G. data obtained was then to be compared with available Navy test data on filter/coalescer OWS systems as well as operational and technical evaluations of the parallel plate type OWS system.

Appendix A of this report is a synopsis of the overall U. S. C. G. OWS program, with respect to the above parameters, as requested by Naval Ship Engineering Center (NAVSEC).

As of 1 January 1976 there were 125 confirmed OWS installations on board U. S. C. G. vessels. Questionnaires were distributed to 105 of these vessels, and 89 vessels responded. Of these, 80 contained sufficient data to be used in the cost and performance calculations in this report. All of the original questionnaires are on file at the Office of the U. S. C. G. Naval Engineering Division, Washington, D.C.

2.0 SCOPE OF OWS INSTALLATION PROGRAM

The U.S.C.G. OWS program, managed by G-ENE, will encompass the entire fleet of approximately 261 vessels. The systems installed are filter coalescer systems and are categorized as follows:

- a. 100 GPM, automatic, built by CAT-A-SEP (Prototype built by SRS). These units are installed on vessels greater than 205 ft in length which ballast.
- b. 10 GPM, automatic, built by SRS (Prototype built by Facet). These units are installed on vessels greater than 110 ft but less than 205 ft in length, which do not ballast.
- c. 5 GPM, manual, built by SRS (Prototype also built by SRS). These units are installed on vessels from 65 ft to 110 ft in length.

To indicate the scope of the OWS program, a proportionate distribution of OWS capacity, and a listing of vessel homeport and system installation data is presented in Table 1.0. This table also represents the 105 vessels which were initially surveyed.

Additionally, installation costs of the OWS systems with respect to the various classes is presented in Table 2.0. A discussion of this table follows:

- a. Vessels per class column - the approximate number of active vessels in class (variable)
- b. Vessels surveyed column - the actual number of questionnaires sent out to the fleet.
- c. Confirmed OWS systems column - those systems installed as of 1 January 1976.
- d. Projected cost column - the projected costs of installation as supplied by G-ENE. Actual installation costs have been lower

TABLE 1.0 - VESSEL HOMEPORT AND INSTALLATION DATA

CLASS VESSEL	VESSEL NAME	HOMEPORT	USCG DISTRICT	INSTALLATION DATE	OWS SYSTEM UTILIZED
WHEC 378 FT	HAMILTON	BOSTON, MA	1	AUGUST 1974	CAT-A-SEP 100 GPM (AUTO)
	CHASE	BOSTON, MA	1	MAY 1975	CAT-A-SEP 100 GPM (AUTO)
	SHERMAN	BOSTON, MA	1	1 AUGUST 1975	CAT-A-SEP 100 GPM (AUTO)
	GALLATIN	NEW YORK, NY	3	1 SEPTEMBER 1975	CAT-A-SEP 100 GPM (AUTO)
	MORGANTHAU	NEW YORK, NY	3	2 OCTOBER 1974	CAT-A-SEP 100 GPM (AUTO)
	MIDGETT	SAN FRANCISCO, CA	12	-----	CAT-A-SEP 100 GPM (AUTO)
	RUSH	SAN FRANCISCO, CA	12	SEPTEMBER 1974	CAT-A-SEP 100 GPM (AUTO)
	GLACIER	LONG BEACH, CA	11	OCTOBER 1974	CAT-A-SEP 100 GPM (AUTO)
	NORTHWIND	BALTIMORE, MD	5	MAY 1975	CAT-A-SEP 100 GPM (AUTO)
	WESTWIND	MILWAUKEE, WI	9	-----	CAT-A-SEP 100 GPM (AUTO)
WMEC 210 FT	DILIGENCE	KEY WEST, FL	7	MAY 1974	CAT-A-SEP 100 GPM (AUTO)
	DECISIVE	NEW CASTLE, NH	1	JULY 1975	CAT-A-SEP 100 GPM (AUTO)
	COURAGEOUS	CAPE CANAVERAL, FL	7	JANUARY 1975	CAT-A-SEP 100 GPM (AUTO)
	STEADFAST	ST. PETERSBURG, FL	7	9 NOVEMBER 1974	CAT-A-SEP 100 GPM (AUTO)
	VALIANT	GALVESTON, TX	8	6 SEPTEMBER 1975	CAT-A-SEP 100 GPM (AUTO)
	VENTUROUS	SAN PEDRO, CA	11	NOT INSTALLED	CAT-A-SEP 100 GPM (AUTO)
	RESOLUTE	SAN FRANCISCO, CA	12	-----	CAT-A-SEP 100 GPM (AUTO)
	ALERT	CAPE MAY, NJ	3	-----	SRS 100 GPM (AUTO) PROTOTYPE
	CHILULA	ATLANTIC BEACH, NC	5	SEPTEMBER 1975	SRS 10 GPM (AUTO)
	BUTTONWOOD	SAN FRANCISCO, CA	12	21 OCTOBER 1975	SRS 10 GPM (AUTO)
WLB 180 FT	IRONWOOD	SEATTLE, WA	13	13 MARCH 1975	SRS 10 GPM (AUTO)
	MARIPOSA	DETROIT, MI	9	NOVEMBER 1974	SRS 10 GPM (AUTO)
	BLACKTHORN	MOBILE, AL	8	JANUARY 1975	SRS 10 GPM (AUTO)
	SALVIA	MOBILE, AL	8	AUGUST 1975	SRS 10 GPM (AUTO)
	BRAMBLE	PORT HURON, MI	9	JULY 1975	SRS 10 GPM (AUTO)
	WOODRUSH	DULUTH, MN	9	JULY 1975	SRS 10 GPM (AUTO)
	MESQUITE	STURGEON BAY, WI	9	17 OCTOBER 1975	SRS 10 GPM (AUTO)
	SEDGE	SEATTLE, WA	13	MAY 1974	SRS 10 GPM (AUTO)
	FIR	SEATTLE, WA	13	JUNE 1975	SRS 10 GPM (AUTO)
	RED CEDAR	PORTSMOUTH, VA	5	JULY 1974	SRS 10 GPM (AUTO)
WLM 175 FT	WHITE PINE	BALTIMORE, MD	5	18 JULY 1975	SRS 10 GPM (AUTO)
	WHITE HOLLY	NEW ORLEANS, LA	8	5 SEPTEMBER 1975	SRS 10 GPM (AUTO)
	WHITE HEATH	BOSTON MA	1	2 DECEMBER 1975	SRS 10 GPM (AUTO)

TABLE 1.0 - VESSEL HOMEPORT AND INSTALLATION DATA (CONT'D)

CLASS VESSEL	VESSEL NAME	HOMEPORT	USCG DISTRICT	INSTALLATION DATE	OWS SYSTEM UTILIZED
WPB 82 FT (CONTD)	POINT TURNER	NEWPORT, RI	1	12 DECEMBER 1975	SRS 5 GPM (MANUAL)
	POINT JACKSON	WOODS HOLE, MA	1	OCTOBER 1975	SRS 5 GPM (MANUAL)
	POINT HANNON	W. JONESPORT, ME	1	3 JULY 1974	SRS 5 GPM (MANUAL)
	POINT BARROW	SAN FRANCISCO, CA	12	OCTOBER 1974	SRS 5 GPM (MANUAL)
	POINT HEYER	SAN FRANCISCO, CA	12	6 APRIL 1974	SRS 5 GPM (MANUAL)
	POINT LEDGE	FORT BRAGG, CA	12	JANUARY 1975	SRS 5 GPM (MANUAL)
	POINT BARNES	PORT PIERCE, FL	7	OCTOBER 1974	SRS 5 GPM (MANUAL)
	POINT CAMDEN	SAN PEDRO, CA	11	MARCH 1975	SRS 5 GPM (MANUAL)
	POINT HOBART	OCEANSIDE, CA	11	MARCH 1975	SRS 5 GPM (MANUAL)
	POINT HARRIS	BODEGO BAY, CA	12	JUNE 1974	SRS 5 GPM (MANUAL)
	POINT DORAN	EVERETT, WA	13	18 MAY 1975	SRS 5 GPM (MANUAL)
	POINT ARENA	NORFOLK, VA	5	15 NOVEMBER 1975	SRS 5 GPM (MANUAL)
	POINT HIGHLAND	CRISFIELD, MD	5	-----	SRS 5 GPM (MANUAL)
	POINT HURON	NORFOLK, VA	5	21 NOVEMBER 1975	SRS 5 GPM (MANUAL)
	POINT CHARLES	CAPE CANAVERAL, FL	7	MARCH 1975	SRS 5 GPM (MANUAL)
	POINT WARDE	SAN JUAN, PR	7	-----	SRS 5 GPM (MANUAL)
	POINT HOPE	SABINE, TX	8	14 MARCH 1975	SRS 5 GPM (MANUAL)
	POINT LOBOS	PANAMA CITY, FL	7	APRIL 1975	SRS 5 GPM (MANUAL)
	POINT ESTERO	GULFPORT, MS	8	-----	SRS 5 GPM (MANUAL)
	POINT SPENCER	NEW ORLEANS, LA	8	3 OCTOBER 1975	SRS 5 GPM (MANUAL)
WLIC 75 FT	POINT EVANS	LONG BEACH, CA	11	2 MAY 1975	SRS 5 GPM (MANUAL)
	POINT BENNETT	PORT TOWNSEND, WA	13	2 MAY 1975	SRS 5 GPM (MANUAL)
	POINT COUNTESS	PORT ANGELES, WA	13	APRIL 1975	SRS 5 GPM (MANUAL)
	POINT GLASS	GIG HARBOR, WA	13	APRIL 1975	SRS 5 GPM (MANUAL)
	POINT RICHMOND	ANACORTES, WA	13	9 MAY 1975	SRS 5 GPM (MANUAL)
WLR 75 FT	HAMMER	FORT PIERCE, FL	7	30 SEPTEMBER 1974	SRS 5 GPM (MANUAL)
	SLEDGE	PORTSMOUTH, VA	5	-----	SRS 5 GPM (MANUAL)
	CLAMP	GALVESTON, TX	8	-----	SRS 5 GPM (MANUAL)
	WEDGE	NEW ORLEANS, LA	8	4 APRIL 1975	SRS 5 GPM (MANUAL)
	MALLET	CORPUS CHRISTI, TX	8	19 MAY 1975	SRS 5 GPM (MANUAL)
WLR 75 FT	HACHET	GALVESTON, TX	8	-----	SRS 5 GPM (MANUAL)
	CHEYENNE	ST. LOUIS, MO	2	15 OCTOBER 1974	SRS 5 GPM (MANUAL)
	CHOCK	NORFOLK, VA	5	MAY 1975	SRS 5 GPM (MANUAL)
WYTL 65 FT	CAPSTAN	ALEXANDRIA, VA	5	DECEMBER 1975	SRS 5 GPM (MANUAL)
WLR 65 FT	OBION	MEMPHIS, TN	2	14 OCTOBER 1975	SRS 5 GPM (MANUAL)
	SANAGAMON	PEORIA, IL	2	14 AUGUST 1975	SRS 5 GPM (MANUAL)

TABLE 2.0 - OILY WATER SEPARATOR INSTALLATION COSTS

CLASS / TYPE VESSEL	VESSELS PER CLASS	VESSELS SURVEYED	CONFIRMED OWS SYSTEMS	PROJECTED VESSEL INSTALLATION COST	INSTALLED COST PER CLASS FOR CUTTERS SURVEYED
WHEC 378 FT HIGH ENDURANCE CUTTERS	12	7	8	\$40K	\$280K
WAGB 400 FT ICEBREAKERS	2	0	0	UNDER CONSTRUCTION	-----
WAGB 310 FT ICEBREAKERS	1	1	1	\$50K	\$ 50K
WAGB 269 FT ICEBREAKERS	2	2	2	\$50K	\$100K
WAGB 290 FT ICEBREAKERS	1	0	0	\$50K	-----
WHEC 327 FT HIGH ENDURANCE CUTTERS	5	0	0	UNKNOWN	-----
WMEC 230 FT MEDIUM ENDURANCE CUTTERS	1	0	0	\$30K	-----
WMEC 210 FT MEDIUM ENDURANCE CUTTERS	16	8	8	\$40K	\$320K
WMEC 210 FT RESERVE MEDIUM ENDURANCE CUTTER	1	0	0	\$40K	-----
WMEC/WAGO 213 FT OCEANGOING TUG	2	0	0	\$30K	-----
WMEC 205 FT OCEANGOING TUG	3	1	1	\$30K	\$ 30K
WMEC 143 FT OCEANGOING TUG	2	0	0	\$25K	-----

TABLE 2.0 - OILY WATER SEPARATOR INSTALLATION COSTS (CONT'D)

CLASS / TYPE VESSEL	VESSELS PER CLASS	VESSELS SURVEYED	CONFIRMED OWS SYSTEMS	PROJECTED VESSEL INSTALLATION COST	INSTALLED COST PER CLASS FOR CUTTERS SURVEYED
WLB 180 FT SEAGOING BUOY TENDERS	35	9	12	\$27K	\$243K
WAGO 180 FT OCEANOGRAPHIC VESSELS	1	0	0	\$30K	-----
WLM 177 FT COASTAL BUOY TENDER	1	0	0	\$27K	-----
WLM 175 FT COASTAL BUOY TENDER	3	1	1	\$27K	\$ 27K
WLM 157 FT COASTAL BUOY TENDER	5	1	1	\$27K	\$ 27K
WLM 133 FT COASTAL BUOY TENDER	7	3	4	\$25K	\$ 75K
WLIC 160 FT INLAND CONSTR BUOY TENDERS	3	0	0	UNDER CONSTRUCTION	-----
WYTM 140 FT MEDIUM HARBOR TUGS	1	0	0	" "	-----
WLV 128 FT LIGHTSHIPS	3	1	1	\$ 3K	\$ 3K
WIX 125 FT/295 FT TRAINING VESSELS	2	0	0	\$26K	-----
WLR 115 FT LARGE RIVER BUOY TENDERS	1	0	1	\$ 3K	-----
WLR 114 FT LARGE RIVER BUOY TENDERS	4	1	2	\$ 3K	\$ 3K

TABLE 2.0 - OILY WATER SEPARATOR INSTALLATION COSTS (CONT'D)

CLASS / TYPE VESSEL	VESSELS PER CLASS	VESSELS SURVEYED	CONFIRMED OWS SYSTEMS	PROJECTED VESSEL INSTALLATION COST	INSTALLED COST PER CLASS FOR CUTTERS SURVEYED
WYTM 110 FT MEDIUM HARBOR TUGS	13	1	2	\$ 3K	\$ 3K
WLIC 100 FT INLAND CONSTR. BUOY TENDERS	8	2	1	\$ 3K	\$ 6K
WPB 95 FT PATROL BOAT	22	17	17	\$ 3K	\$ 51K
WPB 82 FT PATROL BOATS	53	39	44	\$ 3K	\$117K
WYTM 85 FT MEDIUM HARBOR TUGS	1	0	0	\$ 3K	-----
WLI 80 FT SMALL INLAND BUOY TENDERS	1	0	0	\$ 3K	-----
WLR 73 FT/WLR 80 FT SMALL RIVER BUOY TENDERS	2	0	0	\$ 3K	-----
WLR 65 FT SMALL RIVER BUOY TENDERS	6	2	3	\$ 3K	\$ 6K
WYTL 65 FT SMALL HARBOR TUGS	16	2	2	\$ 3K	\$ 6K
WLR 75 FT SMALL RIVER BUOY TENDERS	9	1	5	\$ 3K	\$ 3K
WLIC 75 FT INLAND CONSTR. BUOY TENDER	10	6	6	\$ 3K	\$ 18K
WLI 65 FT SMALL RIVER BUOY TENDERS	6	0	3	\$ 3K	-----

TOTALS

261

105

125

\$1,368,000

than projected costs in most cases, however, an insufficient number of actual cost returns prevented completion of the table in this manner.

e. Installed cost per class for cutters surveyed - vessels surveyed x projected costs.

In an effort to update the OWS program as of 1 January 1976, Table 3.0 was developed, reflecting those vessels with OWS installations which were not surveyed. The total projected installation cost of the 125 confirmed OWS installations reflected in Tables 1.0 and 3.0 is \$1.625 million. Projecting these installation costs to the 261 active vessels, as indicated in Table 3.0, the projected total OWS installation program cost is \$3.5 million.

TABLE 3.0
SEPARATOR SYSTEM INSTALLATIONS NOT SURVEYED

CLASS VESSEL	NAME VESSEL	USCG DISTRICT	HOMEPORT	INSTALLA- TION DATE	PROJECTED INSTALLATION COST
WHEC 378 FT	BOUTWELL	13	SEATTLE, WA	11/75	\$40K
WMEC 210 FT	DEPENDABLE	8	PANAMA CITY, FL	12/75	\$40K
WLB 180 FT	PLANETREE	17	SEATTLE, WA	12/75	\$27K
	SUNDEW	9	CHARLEVOIX, MI	11/75	\$27K
	SWEETBRIAR	17		12/75	\$27K
WLM 133 FT	WHITE SAGE	1	WOODS HOLE, MA	12/75	\$25K
WLR 114 FT	FORSYTHIA	2	GREENVILLE, MS	9/75	\$ 3K
WYTM 110 FT	APALACHEE	5	BALTIMORE, MD	10/75	\$ 3K
WPB 95 FT	CAPE HEDGE	12	MORRO BAY, CA	5/75	\$ 3K
WPB 82 FT	POINT CHICO	12	SAN FRANCISCO, CA	5/75	\$ 3K
	POINT MONROE	8	FREEPORT, TX	12/75	\$ 3K
	POINT BRIDGE	11	VENICE, CA	11/75	\$ 3K
	POINT WINSLOW	12	SAN FRANCISCO, CA	3/75	\$ 3K
	POINT BROWER	11	SAN DIEGO, CA	12/75	\$ 3K
	POINT CARREW	11	SAN PEDRO, CA	10/75	\$ 3K
WLR 75 FT	CHENA	2	NATCHEZ, MS	10/75	\$ 3K
	CHIPPEWA	2	HICKMAN, KY	8/75	\$ 3K
	KANAWHA	2	MEMPHIS, TN	9/75	\$ 3K
	WYACONDA	2	DUBUQUE, IA	9/75	\$ 3K
WLR 65 FT	OSAGE	2	SHEFFIELD, AL	11/75	\$ 3K
WLI 65 FT	BLACKBERRY	5	SOUTHPORT, NC	12/75	\$15K
	BAYBERRY	13	SEATTLE, WA	1/76	\$ 4K
	ELDERBERRY	17	SEATTLE, WA	10/75	\$ 7K
WLR 115 FT	SUMAC	2	KEOKUK, IA	8/75	\$ 3K

3.0 CARTRIDGE USAGE RATE QUESTIONNAIRE

In response to the NAVY's request, G-ENE and G-DET developed a cartridge usage rate questionnaire (Appendix B) to be distributed to the USCG fleet. The questionnaire was designed to obtain the following information, and at the same time create minimum interference to ship-board routine:

- a. cost and expenditure data for cartridges
- b. operating hours and installation date of system
- c. trend of cartridge usage rate (questions D-G)
- d. general remarks on system performance.

Data used in the calculations was obtained from responses received prior to 16 January 1976.

3.1 TREND ANALYSIS

Table 4.0, which summarizes the cartridge usage rate trend analysis for all vessels, proved to be inconclusive. Initially, it was felt that questions D and F would reflect the trend of cartridge usage, and thus, indicate an increase or decrease in OWS system efficiency and cost of operation. As shown in Table 4.0, this was not the case.

Appendix C, details this information by individual vessel response.

TABLE 4.0 - QWS QUESTIONNAIRE RESPONSE SUMMARY

QUESTION D - Cartridge rate higher during first 3 months of operation?

<u>NUMBER OF RESPONSES</u>	<u>YES</u>	<u>NO</u>	<u>N/A OR UNKNOWN</u>
80	36 45.0%	35 43.8%	9 11.2%

QUESTION E - If yes, percent higher.

<u>NUMBER OF RESPONSES</u>	<u><50%</u>	<u>50-100%</u>	<u>MORE THAN 2 X</u>
36	15 41.7%	18 50.0%	3 8.3%

QUESTION F - Current Usage Rate?

<u>NUMBER OF RESPONSES</u>	<u>DECREASING</u>	<u>INCREASING</u>	<u>STEADY</u>	<u>N/A OR UNKNOWN</u>
80	19 23.8%	5 6.2%	51 63.8%	5 6.2%

QUESTION G - Data Accuracy Evaluation.

<u>NUMBER OF RESPONSES</u>	<u>GOOD</u>	<u>FAIR</u>	<u>POOR</u>
80	38 47.5%	38 47.5%	4 5.0%

4.0 CARTRIDGE COST AND EXPENDITURE DATA

Question C of Appendix B (Questionnaire) requested the cartridge expenditure of each vessel by manufacturer and model number. Concurrent with the submission of this data, cartridge manufacturers were contacted to obtain information on cartridge costs. Table 5.0, lists the prices of various filter-coalescer elements by manufacturer and individual model number. In all cases, prices in effect prior to 1 November 1975 were used to calculate cost data in this survey.

Tables 6.0, 7.0 and 8.0 show total cartridge expenditure on an individual ship and system capacity basis as obtained from response to Question C. These tables present both individual ship expenditure and total expenditure by system capacity. A discussion of these tables follows:

- a. Total cost is equal to the number of cartridges expended times the individual price of cartridges as detailed in Table 5.0.
- b. Numbers in lower right hand corner of pages are page totals, and represent the totals for each system capacity.
- c. Table 6.0 reflects those vessels equipped with 100 GPM systems, Table 7.0 reflects 10 GPM installations and Table 8.0 reflects 5 GPM installations.

In the computation of this data, as is the case in all computations, it was assumed that the data supplied by the vessels was accurate and complete to the date of submission.

As indicated on page 4 of Table 8.0, the overall cost of cartridges expended to date is \$33,962.73. This figure represents total expenditure by the 80 vessels submitting usable data, regardless of installation date of the systems. If the individual vessel data submitted is adjusted mathematically to reflect annual costs per vessel for cartridge

TABLE 5.0
FILTER-COALESCE ELEMENT PRICE LISTING

	MODEL NO.	REPLACES	PRICE/EFFECTIVE DATE	OLD PRICE
FACET ENTERPRISES, INC. (FRAM) Telcon w/ Mr. Art Mathews - 31 OCT 75 - 5 JAN 76 (301) 534-4650	TEC-1715 (exp)	Same	\$24.00 22 AUG 75	
	TEC-1684 (exp)	"	\$18.30 12 AUG 75	
	EB-11	"	\$12.50 1 MAR 75	
	EB-12	"	\$14.50 1 MAR 75	
	EB-12-CG-1	"	\$16.80 13 MAR 75	
	EB-12-CG-2	"	\$22.80 13 MAR 75	
	EB-13-CG-1	"	\$16.75 13 MAR 75	
	EB-13-CG-2	"	\$24.00 13 MAR 75	
	C-744	"	\$ 6.10 1 FEB 75	
	PC-11	"	\$12.50 13 MAR 75	
SEPARATOR & RECOVER- ERY SYSTEMS (SRS) Telcon w/Mr. Sam Branson - 31 OCT 75 - 31 DEC 75 (714) 979-8860	CH-58PL	"	\$ 4.50 13 MAR 75	
	CCK-11	"	\$12.50 13 MAR 75	
	614-503	614-620 A	\$14.50 1 NOV 75	\$16.80 15 AUG 74
	611-503	611-621 A	\$14.25 1 NOV 75	\$16.80 15 AUG 74
	614-500	Same	\$ 8.50 1 NOV 75	\$ 8.75 15 AUG 74
	614-503	611-100	\$14.25 1 NOV 75	\$12.60 15 AUG 74
	622-503 (622-100)	614-621 A	\$14.50 1 NOV 75	\$16.80 15 AUG 74
	622-100	622-621 A	\$15.50 1 NOV 75	\$22.40 15 AUG 74
	---	Same	\$15.50 1 NOV 75	\$19.60 15 AUG 74
	---	614-200 A	---	\$15.40 15 AUG 74
MAPCO (CAT-A-SEP) Telcon w/Mr. Partney -3 NOV 75 (918) 584-4471	---	611-620 A	---	\$16.80 15 AUG 74
	---	614-502	---	\$ 8.75 15 AUG 74
	---	611-200	---	\$12.60 15 AUG 74
BALWIN Telcon w/USCGC POINT LEDGE 15 JAN 76 (707) 964-3000	A-0648	Same	\$22.50 last 6-8 mos.	---
	A-0649	Same	\$28.50 last 6-8 mos.	---
	PT-123-5 11 1/8	---	\$ 7.88 Unknown	---

TABLE 7.0 - CARTRIDGE USAGE DATA - (SRS 10 GPM AUTOMATIC OWS)

CLASS VESSEL	NAME VESSEL	CARTRIDGES EXPENDED										TOTAL NO. EXPENDED	COST INCURRED
WMEC 205 FT	CHILULA											0	\$ 0.00
WLB 180 FT	BUTTONWOOD							20				18	\$493.50
	IRONWOOD							6				5	\$153.30
	MARIPOSA							12				10	\$389.90
	BLACKTHORN							5				10	\$171.50
	SALVIA							8				6	\$186.90
WLM 175 FT	BRAMBLE							2					\$369.60
	WOODRUSH											6	\$153.30
	MESQUITE							24					\$470.40
	SEDGE							12				6	\$254.10
	FIR							6				8	\$170.80
WLM 157 FT	RED CEDAR							50				50	\$840.00
WLM 133 FT	WHITE PINE							4				4	\$102.20
	WHITE HOLLY												\$347.30
	WHITE HEATH											2	\$ 17.50
WLR 114 FT	FOXGLOVE*							2	29	4		69	\$759.90
												359	\$4880.20

*NOTE: PROTOTYPE FRAM 10 GPM
AUTOMATIC OWS SYSTEM

TABLE 8.0 - CARTRIDGE USAGE DATA - (SRS 5 GPM MANUAL OWS) (CONT'D)

CLASS VESSEL	NAME VESSEL	CARTRIDGES EXPENDED										TOTAL NO. EXPENDED	COST INCURRED
		POINT THATCHER	5							4		4	\$ 67.20
WPB 82 FT	VERDE		5									12	\$ 148.10
	WELLS											0	\$ 0.00
	BROWN											360	\$ 4536.00
	ROBERTS											4	\$ 67.20
	WHITE HORN											0	\$ 00.00
	LOOKOUT												
	NOWELL											4	\$ 67.20
	SAL											10	\$ 168.00
	STEELE											2	\$ 33.60
	DIVIDE											17	\$ 253.05
	JUDITH											4	\$ 67.20
	STUART											10	\$ 126.00
	BONITA											4	\$ 67.20
	TURNER											2	\$ 33.60
	JACKSON											2	\$ 33.60
	HANNON											3	\$ 50.40
	BARROW											4	\$ 67.20
	HEYER		3									6	\$ 68.70
	LEDGE											10	\$ 114.48
	BARNES		3									6	\$ 68.70
	FACET C-744											464	\$ 6037.43
	FACET CCK-11												
	FACET CH-58-PL												
	BALDWIN PT-123-5												
	SRS 611-200												
	SRS 614-200A												
	SRS 611-100												
	SRS 611-620A												
	SRS 611-621A												
	SRS 614-500												
	SRS 614-620A												
	SRS 611-503												
	CAT-A-SEP A0648												
	CAT-A-SEP A0649												

TABLE 8.0 - CARTRIDGE USAGE DATA - (SRS 5 GPM MANUAL OWS) (CONT'D)

CLASS VESSEL	NAME VESSEL	CARTRIDGES EXPENDED											TOTAL NO. EXPENDED	COST INCURRED
WPB 82 FT	POINT CAMDEN										6		6	\$ 100.80
	HOBART											2	2	\$ 33.60
	HARRIS										4		4	\$ 67.20
	DORAN											3	6	\$ 68.70
	ARENA										1		1	\$ 16.80
	HIGHLAND													
	HURON												0	\$ 0.00
	CHARLES										4		4	\$ 67.20
	WARDE													
	HOPE											5	8	\$ 102.30
	LOBOS										8		8	\$ 134.40
	ESTERO													
	SPENCER										2		2	\$ 33.60
	EVANS										6		6	\$ 100.80
	BENNETT											3	6	\$ 68.70
	COUNTESS									4			8	\$ 91.60
	GLASS											2	4	\$ 45.80
	RICHMOND											2	4	\$ 45.80
	CHEYENNE											2	4	\$ 45.80
	OBION											6	6	\$ 100.80
WLR 75 FT WLR 65 FT	SANGAMON										3		3	\$ 50.40
													82	\$1174.30
		FACET C-744												
		FACET CCK-11												
		FACET CH-58-PL												
		BALDWIN PT-123-5												
		SRS 611-200												
		SRS 614-200A												
		SRS 611-100												
		SRS 611-620A												
		SRS 611-621A												
		SRS 614-500												
		SRS 614-620A												
		SRS 611-503												
		CAT-A-SEP A0648												
		CAT-A-SEP A0649												

expenditure, the following projections can be made:

- a. projected annual cartridge cost of 80 surveyed vessels - \$ 47,134.00
- b. projected annual cartridge cost of 125 confirmed OWS system - \$ 69,085.00
- c. projected annual cartridge cost of 261 active USCG vessels - \$156,129.00

These projections are based on data submitted to date, and may, in some cases, be biased by the limited amount of data obtained for various classes of vessels. Also, these projections do not reflect an anticipated decrease in cartridge coalescer costs, nor do they reflect anticipated increases in cartridge lifespans as a result of current research being conducted by G-ENE.

Additionally, an analysis was conducted to depict overall cartridge expenditure and cost by manufacturer and model number. Table 9, depicts cartridge cost data on an individual cartridge model number and manufacturer basis. The totals in the right hand column represent the total cost by the individual manufacturers.

Lastly, data from Table 9 was utilized to determine the average cost per cartridge for each manufacturer. Results are as follows:

<u>TOTAL NUMBER OF CARTRIDGES EXPENDED</u>	<u>AVERAGE COST PER CARTRIDGE</u>
MAPCO - 695	\$25.65
FACET - 357	\$14.30
SRS - 918	\$13.62
BALDWIN - 6	\$ 7.88

The variance in cost is attributed to system capacity. (i.e., MAPCO is used only in 100 GPM systems; SRS is used primarily in 10 and 5 GPM units, which are smaller, and less expensive to run).

TABLE 9.0

FILTER COALESCER CARTRIDGES EXPENDITURE RECORD(BY MANUFACTURE^R)

		<u>EXPENDITURE TOTAL</u>	<u>COST PER CARTRIDGE</u>	<u>TOTAL COST EXPENDITURE</u>	
<u>MAPCO</u>					
<u>(CAT-A-SEP)</u>	A-0648	330	22.50	7425.00	
	A-0649	365	28.50	10402.50	17827.50
<u>FRAM (FACET)</u>					
	TEC-1684 (EXP)	---	18.30	0.00	
	TEC-1715 (EXP)	---	24.00	0.00	
	EB-11	4	12.50	50.00	
	EB-12	30	14.50	435.00	
	EB-12-CG-1	22	16.80	369.60	
	EB-12-CG-2	120	22.80	2736.00	4861.70
	EB-13-CG-1	16	16.75	268.00	
	EB-13-CG-2	2	24.00	48.00	
	C-744	151	6.10	921.10	
	PC-11	4	12.50	50.00	
	CCK-11	6	12.50	75.00	
	CH-58PL	2	4.50	9.00	
<u>SRS</u>					
	611-100	190	12.60	2394.00	
	611-503	6	16.80	100.80	
	611-620-A	109	16.80	1831.20	
	611-621-A	188	16.80	3158.40	
	614-500	35	8.75	305.75	
	614-502	70	8.75	612.50	
	614-503	6	16.80	100.80	13126.25
	614-620-A	88	16.80	1478.40	
	614-621-A	---	16.80	0.00	
	622-100	40	19.60	784.00	
	622-503	---	22.40	0.00	
	622-621-A	---	22.40	0.00	
	611-200	180	12.60	2268.00	
	614-200-A	6	15.40	92.40	
<u>BALDWIN</u>					
	PT-123-5	6	7.88	47.28	47.28
TOTALS		1976	-----	\$35,962.73	

5.0 OVERALL CARTRIDGE USAGE AND COST DATA

Data presentation thus far has been devoted primarily to cartridge cost and expenditure. An overall analysis of cartridge and system performance is presented in Table 10.0, which shows overall cartridge usage and cost data on a vessel class, system capacity and overall basis.

Table 10.0 calculations were obtained as follows:

- A. Columns A&B - obtained from questionnaire response.
- B. Column B - obtained from Tables 6 through 8.
- C. Column C - Column B divided by column A.
- D. Column E - Column B divided by column D.
- E. Column F - 80 percent of system capacity times number of operating hours times 60 min/hr.
- F. Column G - Column D divided by column A.
- G. Column H - Column F divided by column A.
- H. Column I - Column B divided by column F.

The number of responses listed reflects actual surveys returned, while the number of data points reflects those responses utilized in the calculations. Appendix D, is a complete listing by individual ship, of cartridge data usage. It should be noted that the following data from cutters do not represent a valid base because of (1) the small number of cutters in the class and (2) the minimal amount of operating hours of the OWS systems:

<u>CUTTERS WITH OWS</u>	<u>CLASS</u>	<u>NAME</u>	<u>OPERATING HOURS</u>	<u>COST/GAL GAL</u>
1	WLM 175 FT	FIR	20.0	1.7792
1	WLM 157 FT	RED CEDAR	50.0	3.5000
1	WLI 100 FT	COSMOS	20.0	1.4000
1	WLR 75 FT	CHEYENNE	5.0	3.8167
2	WLR 65 FT	OBION	15.0	4.2000
		SANAGAMON		
2	WYTL	CHOCK	16.0	0.8750
		CAPSTAN		

This data was included in all calculations, however, as the installation date of some vessels dates back to 1974.

The cost of processing effluent data computed in Table 10.0 is illustrated in Figure 1.0 as a function of class of vessel surveyed, total system capacity, and overall cost. In addition, Figures 2.0 through 5.0 illustrate the number of occurrences for various costs in cent per gallon, to process OWS system effluent. Figure 2.0 shows, the overall distribution, Figure 3.0 shows, the cost distribution for 100 GPM systems, Figure 4.0 shows, the cost distribution for 10 GPM systems, and Figure 5.0 shows, the cost distribution for 5 GPM systems.

Figures 6.0 and 7.0 illustrate the lifespan of filter coalescer cartridges in gallons and hours, as presented in Table 10.0. An explanation of these figures follows:

- a. Total bargraph - depicts the overall lifespan figures for the systems.
- b. Remaining bargraphs - depict high, low, and average values for each capacity system, as obtained in Appendix D.
- c. See Appendix D for actual values obtained for each vessel.

TABLE 10.0 - CARTRIDGE USAGE DATA; VESSEL CLASS AND OWS SYSTEM SUMMARIES

A	B	C	D	E	F	G	H	I	
	TOTAL NO. CARTRIDGE EXPENDED	TOTAL CARTRIDGE COST	AVERAGE COST PER CARTRIDGE	SYSTEM OPERATING HOURS	CARTRIDGE COST PER OPER HOUR	ESTIMATE OF GALLONS PROCESSED	CARTRIDGE LIFESPAN IN HOURS	CARTRIDGE LIFESPAN IN GALLONS	COST/GAL PROCESSED (CENTS)
CLASS/NAME OF VESSEL									
WHEC 378 FT	539	13250.40	24.58	818.0	16.20	3,926,400	1.52	7285	0.3375
WMEC 210 FT	250	5413.00	21.65	905.9	5.98	4,348,320	3.62	17393	0.1245
WAGB 310 & 269 FT	100	2227.00	22.27	112.0	19.88	537,600	1.12	5376	0.4142
100 GPM TOTALS	889	20890.40	23.50	1835.9	11.38	8,812,320	2.07	9913	0.2371

RESPONSES - 14
DATA POINTS - 13

WMEC 205 FT		-----NO DATA OBTAINED-----							
187	WLB 180 FT	2642.50	14.13	804.3	3.29	386,064	4.30	2065	0.6845
14	WLM 175 FT	170.80	12.20	20.0	8.54	9,600	1.43	686	1.7792
50	WLM 157 FT	840.00	16.80	50.0	16.80	24,000	1.00	480	3.5000
39	WLM 133 FT	467.00	11.92	215.8	2.16	103,584	5.53	2656	0.4508
69	WLR 114 FT	759.90	11.01	258.9	2.94	124,272	3.75	1801	0.6115
10 GPM TOTALS		4880.20	13.59	1349.0	3.62	647,520	3.76	1804	0.7537

RESPONSES - 16
DATA POINTS - 15

TABLE 10.0 - CARTRIDGE USAGE DATA; VESSEL CLASS AND OWS SYSTEM SUMMARIES

CLASS/NAME OF VESSEL	A	B	C	D	E	F	G	H	I
	TOTAL NO. CARTRIDGE EXPENDED	TOTAL CARTRIDGE COST	AVERAGE COST PER CARTRIDGE	SYSTEM OPERATING HOURS	CARTRIDGE COST PER OPER HOUR	ESTIMATE OF GALLONS PROCESSED	CARTRIDGE LIFESPAN IN HOURS	CARTRIDGE LIFESPAN IN GALLONS	COST/GAL PROCESSED (CENTS)
WLV 128 FT									
WYTM 110 FT									
WLI 100 FT	4	67.20	16.80	20.0	3.36	4,800	5.00	1200	1.4000
WPB 95 FT	160	2653.60	16.59	675.5	3.93	162,120	4.22	1013	1.6368
WPB 82 FT	533	7014.73	13.16	2299.5	3.05	551,880	4.31	1035	1.2711
WLIC 75 FT	16	226.00	14.13	400.0	0.57	96,000	25.00	6000	0.2354
WLR 75 FT	4	45.80	11.45	5.0	9.16	1,200	1.25	300	3.8167
WLR 65 FT	9	151.20	16.80	15.0	10.08	3,600	1.67	400	4.2000
WYTL 65 FT	2	33.60	16.80	16.0	2.10	3,480	8.00	1920	0.8750
5 GPM TOTALS	728	10192.13	14.00	3431.0	2.97	823,440	4.71	1131	1.2378
# RESPONSES - 59									
# DATA POINTS - 55									
OVERALL TOTALS	1976	35962.73	18.20	6615.9	5.44	10,283,280	3.35	5204	0.3497
# RESPONSES - 89									
# DATA POINTS - 83									

FIGURE 1.0 - COST OF PROCESSING EFFLUENT - VS- 70551 CLASS

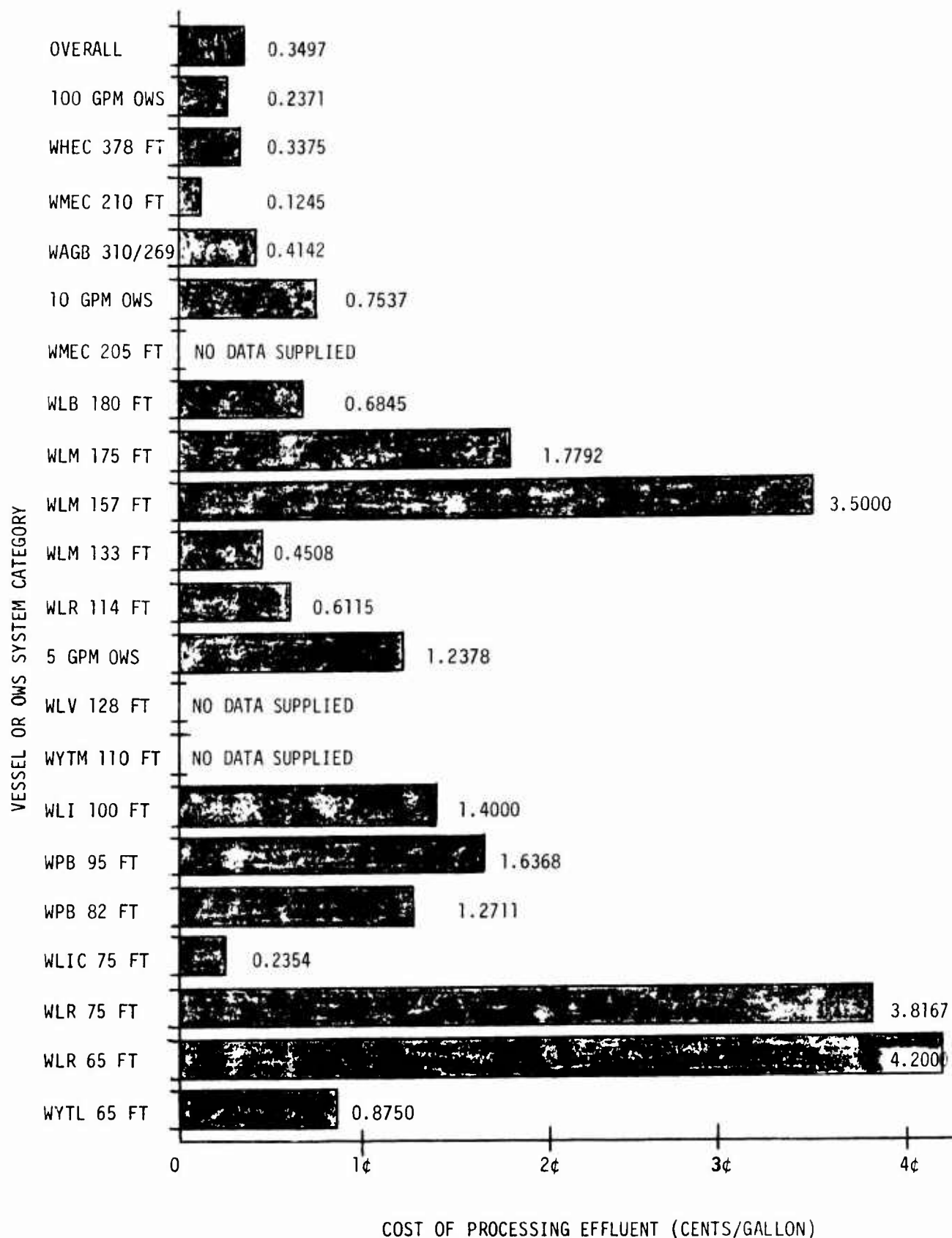


FIGURE 2.0 - OVERALL COST DISTRIBUTION (COST -vs- NO. OF OCCURENCES)

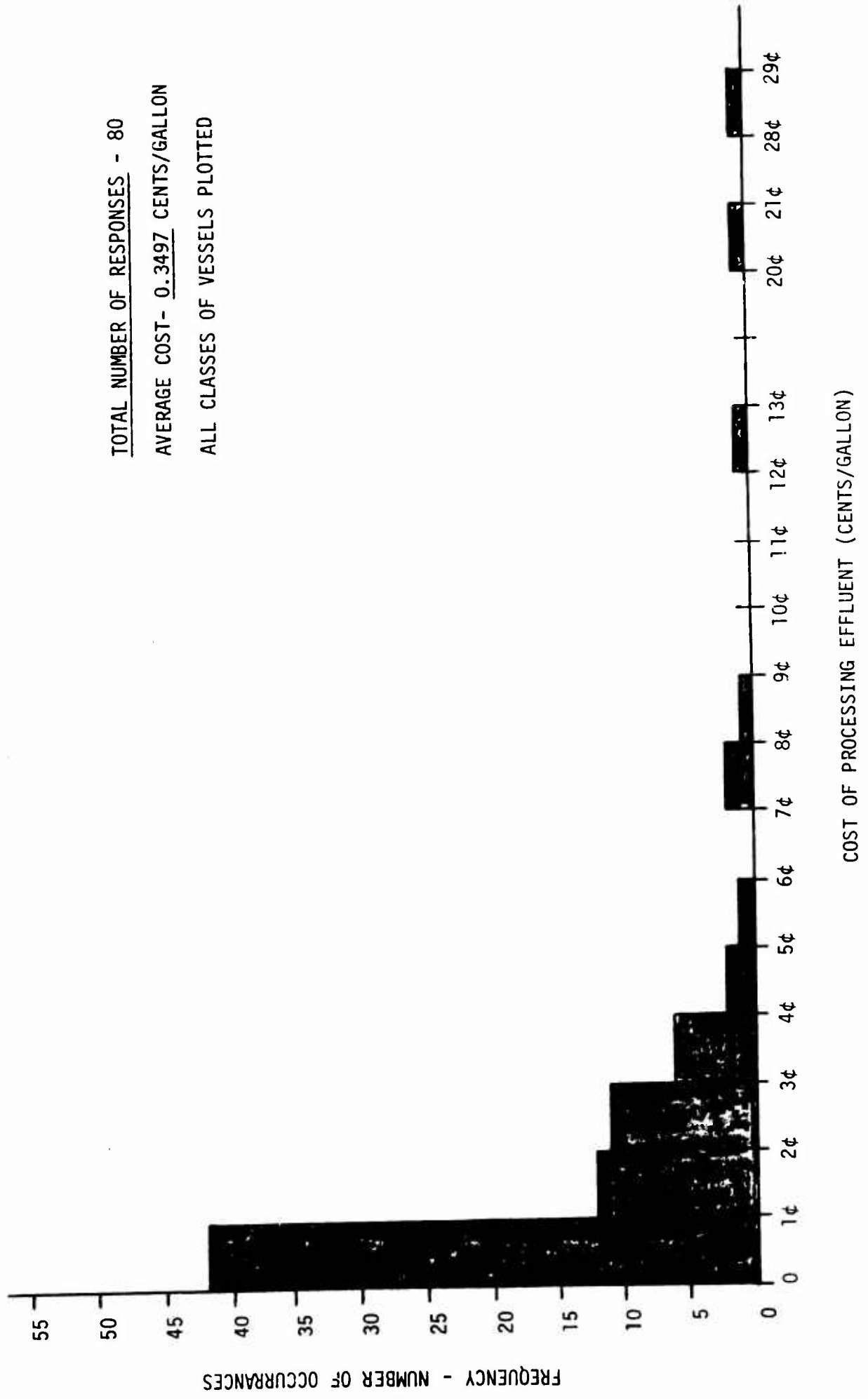


FIGURE 3.0 - 100 GPM SYSTEM COST DISTRIBUTION (COST -vs- NO. OF OCCURRENCES)

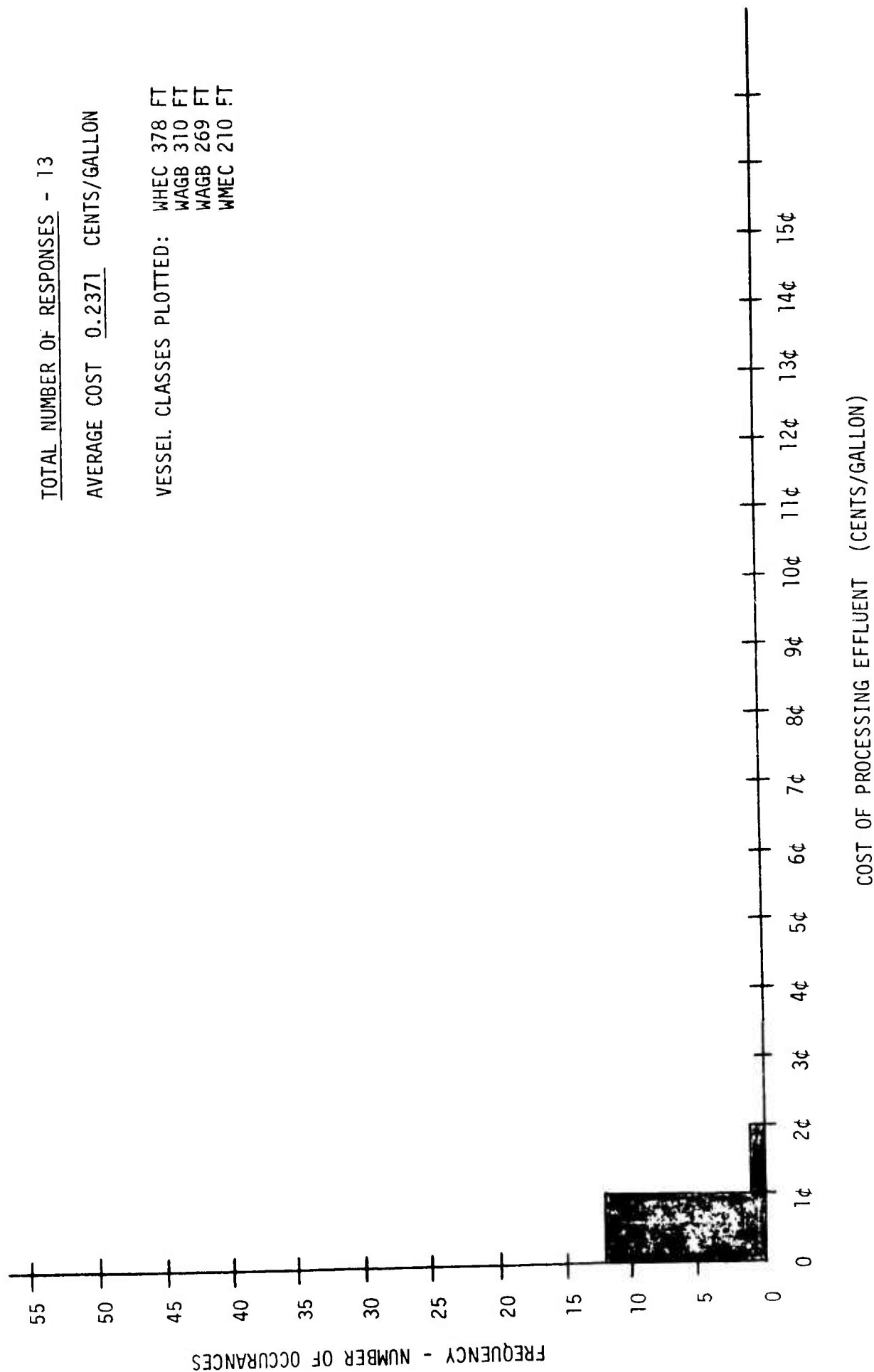


FIGURE 4.0 - 10 GPM SYSTEM COST DISTRIBUTION (COST -vs- NO. OF OCCURENCES)

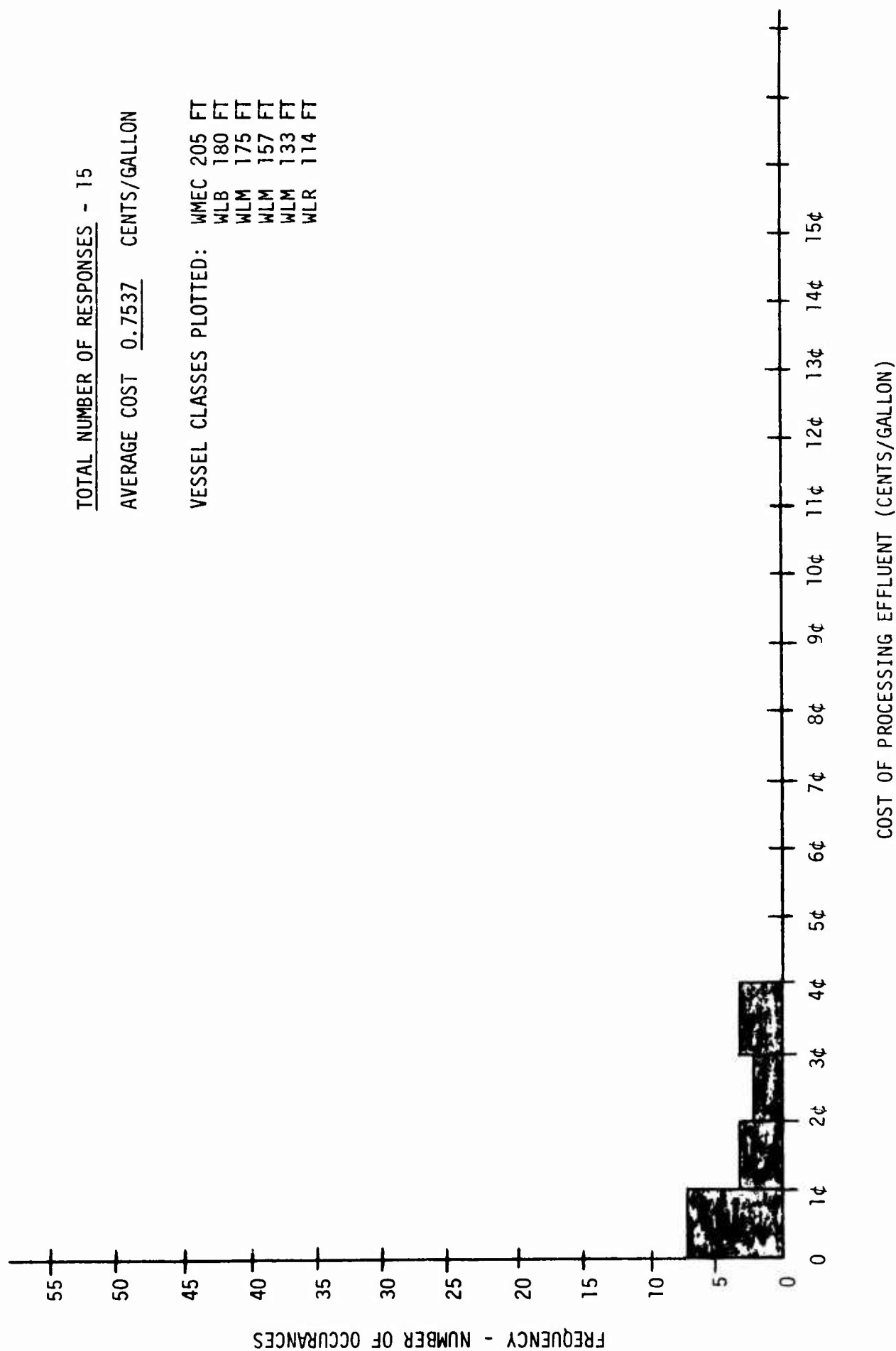


FIGURE 5.0 - 5 GPM SYSTEM COST DISTRIBUTION (COST -vs- NO. OF OCCURRENCES)

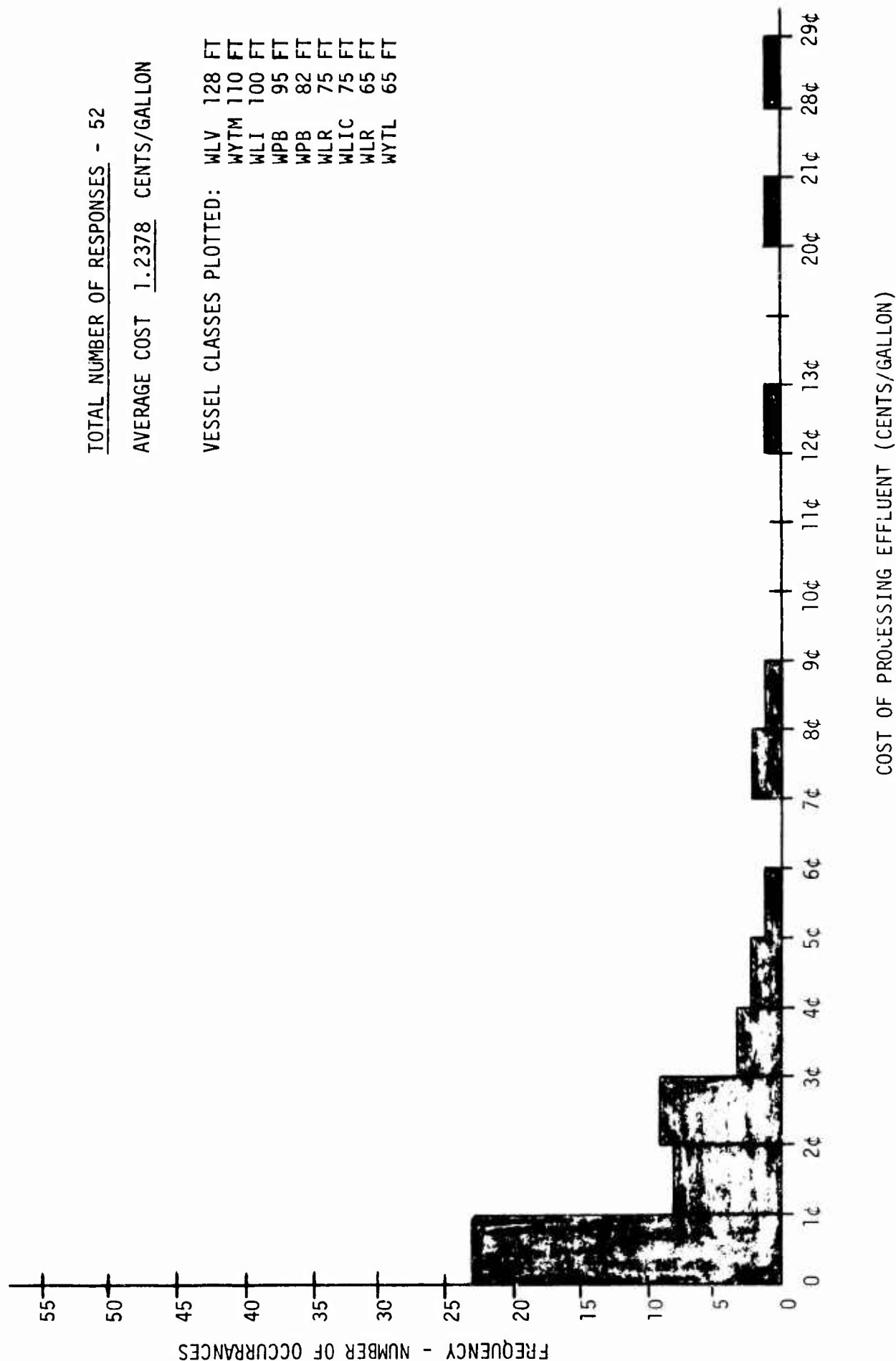


FIGURE 6.0 - CARTRIDGE LIFESPAN (GALLONS) -vs- OWS SYSTEMS

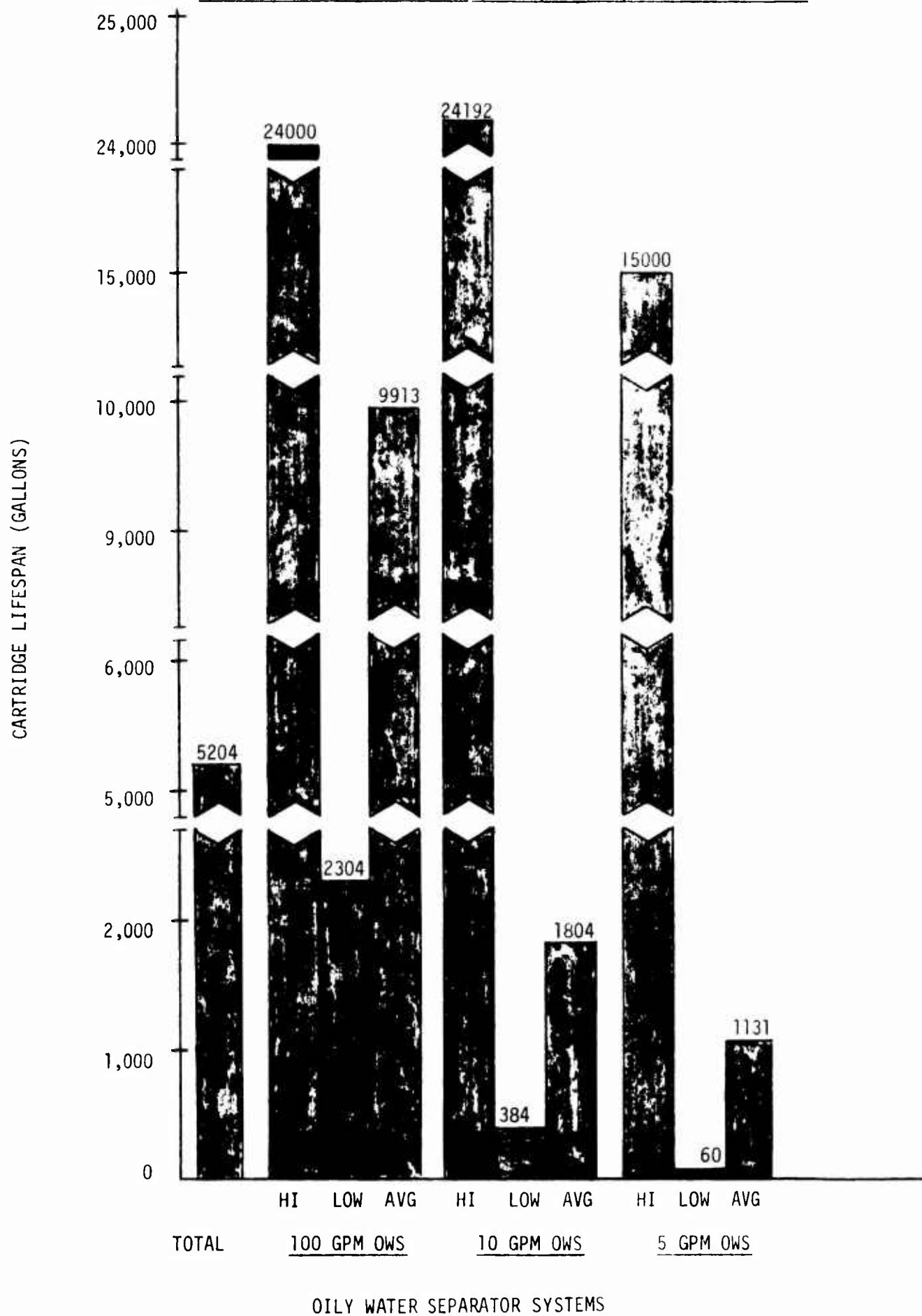
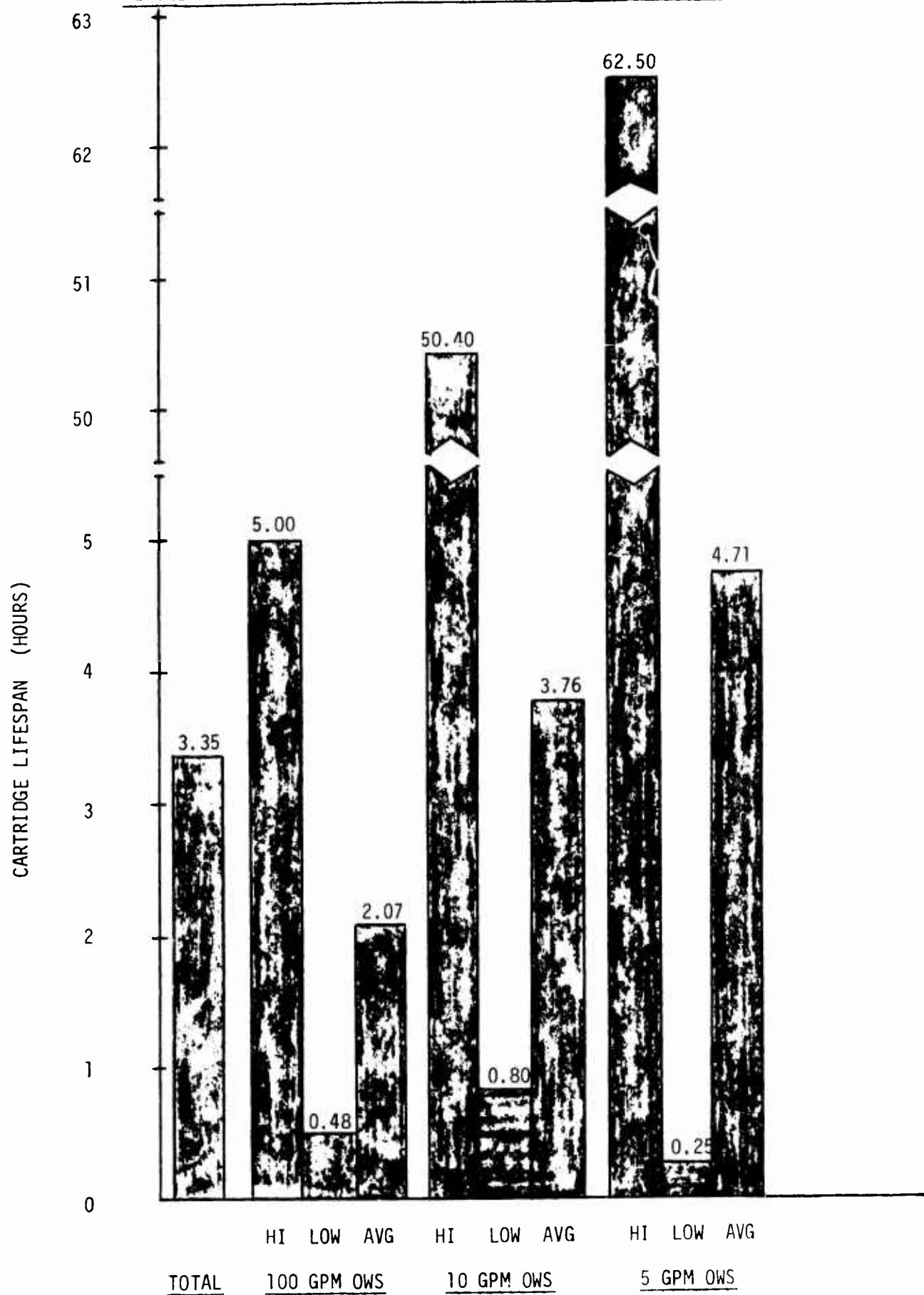


FIGURE 7.0 - CARTRIDGE LIFESPAN (HOURS) -vs- OWS SYSTEMS



OILY WATER SEPARATOR SYSTEMS

6.0 GEOGRAPHICAL ANALYSIS

A geographical analysis of the data was performed to determine the dependence of effluent processing cost on geographical location.

Table 11.0 details the geographical distribution of the ships surveyed, and illustrates the breakdown of the survey into regions, as defined by Coast Guard Districts. Table 11.0 also shows vessels not responding to the survey, regional responses to the survey, and the regional cost of processing effluent. Again, the number of surveys plotted (80) depicts those responses containing sufficient data to calculate the cost of processing effluent.

The results presented in Table 11.0 are inconclusive, with the 3rd region (Gulf Coast), the only possible exception. The low cost of processing effluent occurring here may be attributed to the following factors:

- a. Climate
- b. Vessel or district "housekeeping" or maintenance programs
- c. Vessel or system distribution in region.

Table 12.0 is a geographic distribution of OWS systems by system capacity. This table indicates that distribution of the OWS systems is not a factor in the low cost of region 3 (Table 11.0).

No direct analysis is possible from the data, however the significantly low cost figure is worth noting. Further investigation into that region's OWS program could reveal factors or practices which substantially reduce overall cost. Appendix E, is a breakdown of regions into the individual vessel totals used to calculate cost per gallon shown in Table 11.0.

TABLE 11.0

GEOGRAPHICAL DISTRIBUTION OF SURVEYS

REGION 1 - INLAND - USCG DISTRICTS 2 & 9
 REGION 2 - EAST COAST - USCG DISTRICTS 1, 3 & 5
 REGION 3 - GULF COAST - USCG DISTRICTS 7 & 8
 REGION 4 - SOUTHWEST COAST - USCG DISTRICTS 13 & 17
 REGION 5 - NORTHWEST COAST - USCG DISTRICTS 11, 12 & 14

	<u>SURVEYS DISTRIBUTED</u>	<u>SURVEYS RECEIVED</u>	<u>SURVEYS PLOTTED</u>	<u>AVERAGE COST/ GAL EFFLUENT</u>
REGION 1	10	9	8	0.6903 CENTS
REGION 2	31	25	20	0.4026 "
REGION 3	31	25	23	0.1614 "
REGION 4	12	11	11	0.7753 "
REGION 5	21	19	18	0.6191 "
	<u>105</u>	<u>89</u>	<u>80</u>	<u>0.3497 CENTS</u>
		84.48%	76.19%	

<u>VESSELS NOT RESPONDING TO SURVEY</u>	<u>USCG DISTRICT</u>
378 FT CLASS - CGC MIDGETT	12
269 FT CLASS - CGC WESTWIND	9
210 FT CLASS - CGC RESOLUTE	12
- CGC ALERT	3
128 FT CLASS - CGC PORTLAND	1
110 FT CLASS - CGC MOHICAN	5
95 FT CLASS - CAPE FOX	7
- CAPE JELLISON	13
- CAPE HORN	1
82 FT CLASS - POINT LOOKOUT	8
- POINT HIGHLAND	5
- POINT WARDE	7 (NOT INSTALLED)
- POINT ESTERO	8
75 FT CLASS - SLEDGE	5
- CLAMP	8
- HATCHET	8

TABLE 12.0 - DISTRIBUTION OF OWS SYSTEMS (SYSTEM CAPACITY) BY GEOGRAPHICAL REGIONS

<u>GEOGRAPHICAL REGION</u>	<u>USCG DISTRICTS</u>	<u>TOTAL NO OWS SYSTEM RESPONSES</u>	<u>DISTRIBUTION OF OWS SYSTEMS BY CAPACITY</u>		
			<u>100 GPM</u>	<u>10 GPM</u>	<u>5 GPM</u>
1	2 & 9	8	0	5	3
2	1, 3 & 5	20	7	3	10
3	7 & 8	23	4	3	16
4	13 & 17	11	0	3	8
5	11, 12 & 14	18	2	1	15
TOTALS		80	13	15	52

7.0 SUMMARY

In the survey of 105 USCG vessels, 80 installations were utilized as data points to compute usage and cost data. The following figures represent the cost to process OWS system effluent:

- a. overall (80 vessels) - 0.3497 cents/gallon
- b. 100 GPM OWS systems - 0.2371 cents/gallon
- c. 10 GPM OWS systems - 0.7537 cents/gallon
- d. 5 GPM OWS systems - 1.2378 cents/gallon

(costs computed from cartridge expenditure cost; maintenance, installation and repair cost are not included)

In addition, the following data applies to the overall OWS program:

- a. average cost per cartridge - \$18.20
- b. cartridge cost per operating hour - \$5.44
- c. cartridge lifespan in hours - 3.35 hrs.
- d. cartridge lifespan in gallons - 5204 gals.

Individual vessel, vessel class and system capacity totals are included in the report.

It should be noted that several projects are being undertaken by G-ENE to lower maintenance costs. These include (1) tests of larger micron rating filter-coalescer elements, and (2) tests of a parallel plate OWS on a 327 FT WHEC. If successful, modifications to replace the first stage of existing units with a parallel plate separator would extend cartridge life by removing most of the particulate matter with oil in the first stage.

The data compiled in this report was obtained for the Office of Naval Engineering (G-ENE), the Naval Ship Engineering Center (NAVSEC) and the Naval Sea Systems Command (NAVSEA) upon request. It must be

stressed that the projections and conclusions presented are based on a limited amount of data, and that the various parameters involved in assuring the reliability of this data were not controlled. Assumptions made throughout the report were noted were applicable.

APPENDIX A

U. S. COAST GUARD OIL WATER

SEPARATOR PROGRAM SURVEY

APPENDIX A - U.S. COAST GUARD OIL WATER SEPARATOR PROGRAM SURVEY

PURPOSE: To determine the suitability of utilizing a filter/coalescer type oil water separator on U. S. Navy vessels by accessing the installation, operation, maintenance and logistics of a similar oil water separator on USCG ships.

I. SHIPBOARD PARAMETERS

1. How many ships are to receive OWS's? Ideally, the entire fleet (approximately 261 active vessels). As of 1 January 1976, 125 OWS systems were installed.
2. What is the capacity of those OWS's? 5 GPM for vessels 65-110 FT in length, 10 GPM for vessels 110-205 FT in length and 100 GPM for vessels > 205 FT in length which ballast.
3. What is the propulsion system on those ships? Diesel and/or gas turbine.
4. What are the generation rates of oily waste on the ships?
Variable - No data available.
5. What are the sources of oily waste? Lube oil and fuel oil leakoff, piping or machinery failure.
6. What are the dirt and oil concentrations? Variable - No data available.
7. What cleaning method is used to clean equipment and bilges? Spot cleaners, (spray on-wipe off); diesel oil and hot water washdown.
8. How frequently is cleaning accomplished? Weekly.
9. What is the method of dewatering bilges without OWS's? Only alternative is to pump into a tank truck or a barge ashore.

II. INSTALLATION

1. What is the cost to install and pipe up the OWS on various size ships? See Table 2.0
2. How is the OWS piped to drain all bilge spaces? Utilize existing bilge system (except in case of eductor bilge systems, where a separate system is installed).
3. What spaces that have bilge water are not piped? Non-oily spaces.
4. Is existing ships piping used? See II-2 above.

APPENDIX A

5. What type deck connection is used? Hose; bibb
6. How are bilges cleaned to support installation? Bilges are cleaned commercially and flushed thoroughly with fresh water.
7. Are bilges recleaned periodically? Flushed by ships force only.
8. What size of oily waste or waste oil tanks are provided? Varies with vessel size - use existing tanks in some cases. New designs are 100% of one (1) main propulsion engine sump.
9. Is ballast processed with OWS. Yes

III. OPERATION

1. Is OWS operated at sea? Yes
2. Is monitor bypassed? No
3. What are OWS operating instructions? Use each time bilges are pumped or tanks deballasted.
4. What effluent samples are taken, how taken, where analyzed and how? No samples are taken on a routine basis.
5. What type of elements perform best and how determined to be best? Not determined to date.
6. Are OWS's doing better performance-wise with cleaned bilges and how determined? Absolutely - filter usage rate is lower as reported by individual vessels.
7. Is performance of OWS dependent on type of bilge pump? Not when OWS is used in deballast mode. The efficiency of the OWS is dependent upon pump type.
8. Does OWS start automatically? No
9. When is OWS utilized - bilge level? Variable - (decision of OOD, Engineering Watch Officer, & Ship Standing Orders). Wet bilge is preferred.
10. How much oil concentrate is collected and what is it's concentration? Unknown - No data available.
11. Is concentrated oil remixed and if so, how is it controlled? Unknown.
12. What is flow rate of OWS? 5, 10 & 100 GPM. (100 GPM unit is operated at 20-40 GPM when pumping bilges).

APPENDIX A

13. What is the pump used? Air diaphragm and progressing cavity pumps - when in deballast mode a centrifugal pump is used.
14. How often is monitor operable? Whenever system is operated.
15. How many gallons are processed daily, monthly? Variable - a function of oily waste generation rates, for which no data is available.
16. How is OWS used if monitor not working or if working and recycles, how are bilges pumped? Inport the OWS discharges to tank truck or barge - at sea, discharge is to dirty oil tanks and in an emergency - overboard. Monitor recycles effluent to bilge until PPM level is below discharge limit.
17. What is mode of operation - auto, manual? The 10 & 100 GPM systems are automatic - the 5 GPM systems are manual.
18. What time spent monitoring operation and rating? Variable - no data available.

IV. MAINTENANCE

1. How frequently are prefilter elements replaced?
 - a. Gallons processed - No available data.
 - b. Pressure drop - 25 psi.
2. How frequently are coalescer elements replaced?
 - a. Gallons processed - No available data.
 - b. Pressure drop - 25 psi.
3. Are elements replaced throughout OWS? No - only those elements which require replacement, as indicated by the ΔP reading.
4. How frequently is monitor window cleaned? Optional - cleaning is dependent upon the zero gain of the monitor.
5. What is maintenance required on OWS? Outlined in operating instructions/manuals.
6. What is spent element disposition? Returned to new element carton, retained until inport and disposed of ashore.
7. How much operator time is required? Actual operator time is minimal (start up, shut down and occasional monitoring).
8. What rating maintains OWS? MK2 (Machinery Technician Second Class) and above - occasional help is required of EM1 (Electricians Mate First Class) and above.

APPENDIX A

V. LOGISTICS

1. How are elements procured? Commercially, by the individual vessel.
2. How are OWS procured? By contract - Advertising on specifications.
3. Does ship buy elements? Presently, individual vessels procure elements. Eventually CG will stock the elements at CG YARD (SICP).
4. How are elements stored on ship? Elements are stored in vessel storerooms in their original cartons.
5. How many elements are stored? 90 day supply (except WAGB class vessels - 6 months supply).
6. What is projected usage rate? Variable. Cartridge lifespan (to date) in hours and gallons is outlined in Table 10.0, Appendix D and Figures 6.0 and 7.0.
7. What is QA on elements? G-ENE specifications dictate rating and size of elements, only.
8. Are different elements from various manufacturers interchanged? Yes, See Tables 5.0, 6.0, 7.0 and 8.0.
9. Are coalescer element costs decreasing? Yes. See Table 5.0.
10. What is price paid for elements? See Table 5.0.

Prepared by J. Powderly/D. Waters, NAVSEC 6159D 10/20/75

Answered by C. Wade, USCG, G-ENE and R. L. Skewes, USCG,
G-DET-1/62, 1/22/76

APPENDIX B

OIL WATER SEPARATOR SYSTEM
CARTRIDGE USAGE DATA QUESTIONNAIRE

APPENDIX B - OIL WATER SEPARATOR SYSTEM CARTRIDGE USAGE DATA QUESTIONNAIRE



DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS
U.S. COAST GUARD (G-ENE-4/64)
400 SEVENTH STREET SW
WASHINGTON, D.C. 20590
PHONE: 202-426-1302


9000

18 NOV 1976

From: Commandant
To: Commanding Officer, USCGC
Via: Commander,

Subj: Oily Water Separator System Cartridge Usage Data; request for

1. To facilitate planning and provide needed operational data on cartridge usage rate, the enclosed questionnaire is forwarded for completion by 5 January 1976. Questionnaires shall be prepared in duplicate. Submit original directly to Commandant(G-DET-1/62) and copy to cognizant district(e).


BARRY Z. ROBERTS
By direction

Encl: (1) Questionnaires

(DATE)

FIRST ENDORSEMENT

From: Commander,
To: Commanding Officer, USCGC

Subj: Oily Water Separator System Cartridge Usage Data; request for

1. Forwarded; for submission as directed.

APPENDIX B

QUESTIONNAIRE

USCGC _____

Date of Completion _____

WHERE REQUESTED INFORMATION IS NOT AVAILABLE, PLEASE USE BEST ESTIMATE.

- a. Installation date of oily water separator system _____
- b. Operating hours of system to date _____
- c. Cartridge information:

TYPE (MANUFACTURER/MODEL NO.)	NUMBER USED TO DATE	TYPE (MANUFACTURER/MODEL NO.)	NUMBER USED TO DATE
FRAM EB 11	_____	SRS 622-621 A	_____
SRS 614-620A	_____	CATA-SEP A-0649	_____
FRAM EB-12-CG-1	_____	FRAM EB-13-CG-2	_____
SRS 611-621-A	_____	SRS 622-100	_____
FRAM C-744	_____	CATA-SEP A-0648	_____
SRS 614-500	_____	SRS 614-503	_____
FRAM EB-13-CG-1	_____	OTHER (SPECIFY):	_____
SRS 611-100	_____	_____	_____
FRAM EB-12	_____	_____	_____
SRS 614-621-A	_____	_____	_____
FRAM EB-12-CG-2	_____	_____	_____

- d. Was the cartridge usage rate higher during the first three months of operation than the current usage rate? YES NO

- e. If the answer to "d" is yes, approximately how much higher:

less than 50% more _____
 50 to 100% more _____
 More than twice as much _____

- f. Is the current usage rate steady, increasing or declining? _____

- g. Assign an accuracy/reliability evaluation to the above data:

GOOD FAIR POOR

- h. Remarks: [Include applicable operational data, cartridge availability and performance, problems, applications of separator (cleaning fuel oil tanks, bilges); etc.] (Continue on reverse).

Commanding Officer's Signature _____

Forward to: Commandant(G-DET-1/62)

APPENDIX B

QUESTIONNAIRE

USCGC _____ Date of Completion _____

WHERE REQUESTED INFORMATION IS NOT AVAILABLE, PLEASE USE BEST ESTIMATE.

- a. Installation date of oily water separator system _____
- b. Operating hours of system to date _____
- c. Cartridge information:

<u>TYPE</u> <u>(MANUFACTURER/MODEL NO.)</u>	<u>NUMBER USED</u> <u>TO DATE</u>	<u>TYPE</u> <u>(MANUFACTURER/MODEL NO.)</u>	<u>NUMBER USED</u> <u>TO DATE</u>
FRAM EB 11	_____	SRS 622-621 A	_____
SRS 614-620A	_____	CATA-SEP A-0649	_____
FRAM EB-12-CG-1	_____	FRAM EB-13-CG-2	_____
SRS 611-621-A	_____	SRS 622-100	_____
FRAM C-744	_____	CATA-SEP A-0648	_____
SRS 614-500	_____	SRS 614-503	_____
FRAM EB-13-CG-1	_____		
SRS 611-100	_____	OTHER (SPECIFY):	
FRAM EB-12	_____	_____	_____
SRS 614-621-A	_____	_____	_____
FRAM EB-12-CG-2	_____	_____	_____

d. Was the cartridge usage rate higher during the first three months of operation than the current usage rate? YES NO

e. If the answer to "d" is yes, approximately how much higher:

less than 50% more _____

50 to 100% more _____

More than twice as much _____

f. Is the current usage rate steady, increasing or declining? _____

g. Assign an accuracy/reliability evaluation to the above data:

GOOD FAIR POOR

h. Remarks: [Include applicable operational data, cartridge availability and performance, problems, applications of separator (cleaning fuel oil tanks, bilges); etc.] (Continue on reverse).

Commanding Officer's Signature _____

Forward to: Commander, _____ Coast Guard District(e)

APPENDIX C

INDIVIDUAL VESSEL RESPONSE TO OWS

QUESTIONNAIRE (CARTRIDGE USAGE

RATE TRENDS)

APPENDIX C - INDIVIDUAL VESSEL RESPONSE TO OWS QUESTIONNAIRE (CARTRIDGE USAGE RATE TRENDS)

<u>CLASS/ NAME VESSEL</u>	<u>CARTRIDGE RATE HIGHER DURING FIRST 3 MONTHS OF OPERATION</u>	<u>IF YES, PERCENT HIGHER</u>	<u>CURRENT USAGE RATE</u>	<u>DATA ACCURACY EVALUATION</u>
<u>WHEC 378 FT</u>				
HAMILTION	NO	N/A	INCREASING	GOOD
CHASE	YES	MORE THAN 2X	STEADY	GOOD
SHERMAN	NO	N/A	STEADY	GOOD
GALLATIN	N/A	N/A	DECLINING	GOOD
MORGANTHAU	YES	50-100%	DECLINING	FAIR
MIDGETT	-----NO RESPONSE-----			
RUSH	NO	< 50%	STEADY	FAIR
<u>WMEC 210 FT</u>				
DILIGENCE	YES	50-100%	STEADY	FAIR
DECISIVE	YES	< 50%	STEADY	GOOD
COURAGEOUS	UNKNOWN	N/A	STEADY	GOOD
STEADFAST	YES	50-100%	STEADY	GOOD
VALIANT	YES	50-100%	STEADY	GOOD
VENTUROUS	-----NOT INSTALLED-----			
RESOLUTE	-----NO RESPONSE-----			
ALERT	-----NO RESPONSE-----			
<u>WAGB 310 FT</u>				
GLACIER	YES	50-100%	DECLINING	FAIR
<u>WAGB 269 FT</u>				
NORTHWIND	UNKNOWN	N/A	STEADY	POOR
WESTWIND	-----NO RESPONSE-----			
<u>WMEC 205 FT</u>				
CHILULA	-----FLUID ANALYZER REPAIRS-----			
<u>WLB 180 FT</u>				
BUTTONWOOD	UNKNOWN	N/A	UNKNOWN	GOOD
IRONWOOD	NO	N/A	INCREASING	GOOD
MARIPOSA	YES	< 50%	STEADY	GOOD
BLACKTHORN	YES	50-100%	DECLINING	FAIR
SALVIA	YES	< 50%	STEADY	GOOD
BRAMBLE	NO	N/A	STEADY	FAIR
WOODRUSH	N/A	N/A	N/A	GOOD
MESQUITE	N/A	N/A	DECLINING	GOOD
SEDGE	YES	50-100%	DECLINING	FAIR

APPENDIX C

<u>CLASS/ NAME VESSEL</u>	<u>CARTRIDGE RATE HIGHER DURING FIRST 3 MONTHS OF OPERATION</u>	<u>IF YES, PERCENT HIGHER</u>	<u>CURRENT USAGE RATE</u>	<u>DATA ACCURACY EVALUATION</u>
<u>WLB 175 FT</u>				
FIR	YES	< 50%	UNKNOWN	GOOD
<u>WLM 157 FT</u>				
RED CEDAR	NO	N/A	STEADY	GOOD
<u>WLM 133 FT</u>				
WHITE PINE	YES	50-100%	DECLINING	FAIR
WHITE HOLLY	YES	50-100%	STEADY	GOOD
WHITE HEATH	NO	N/A	STEADY	GOOD
<u>WLR 114 FT</u>				
FOXGLOVE	NO	N/A	STEADY	FAIR
<u>WLV 128 FT</u>				
PORTLAND	-----NO RESPONSE-----			
<u>WYTM 110 FT</u>				
MOHICAN	-----NO RESPONSE-----			
<u>WLI 100 FT</u>				
COSMOS	YES	< 50%	DECLINING	GOOD
BUCKTHORN	-----NOT INSTALLED-----			
<u>WPB 95 FT</u>				
CAPE CARTER	NO	N/A	DECLINING	GOOD
CAPE WASH	YES	50-100%	DECLINING	FAIR
CAPE SMALL	YES	< 50%	DECLINING	FAIR
CAPE FOX	-----NO RESPONSE-----			
CAPE KNOX	NO	N/A	DECLINING	FAIR
CAPE NEWAGEN	NO	N/A	STEADY	FAIR
CAPE JELLISON	-----NO RESPONSE-----			
CAPE HORN	-----NO RESPONSE-----			
CAPE YORK	NO	N/A	STEADY	POOR
CAPE CORWIN	YES	< 50%	STEADY	GOOD
CAPE CROSS	NO	N/A	STEADY	FAIR
CAPE GEORGE	NO	N/A	STEADY	GOOD
CAPE FAIRWEATHER	-----NOT INSTALLED-----			

APPENDIX C

CLASS/ NAME VESSEL	CARTRIDGE RATE HIGHER DURING FIRST 3 MONTHS OF OPERATION	IF YES, PERCENT HIGHER	CURRENT USAGE RATE	DATA ACCURACY EVALUATION
<u>WPB 95 FT (CONT)</u>				
CAPE MORGAN	YES	< 50%	STEADY	FAIR
CAPE SHOALWATER	YES	< 50%	STEADY	GOOD
CAPE ROMAIN	YES	50-100%	STEADY	FAIR
CAPE CORAL	NO	N/A	STEADY	FAIR
<u>WPB 82 FT</u>				
POINT THATCHER	NO	N/A	STEADY	GOOD
POINT VERDE	NO	N/A	STEADY	FAIR
POINT WELLS	-----UNKNOWN - NO DATA SUPPLIED-----			
POINT BROWN	YES	< 50%	STEADY	FAIR
POINT ROBERTS	YES	50-100%	INCREASING	FAIR
POINT WHITEHORN	-----UNKNOWN - NO DATA SUPPLIED-----			
POINT LOOKOUT	-----NO RESPONSE-----			
POINT NOWELL	YES	50-100%	DECLINING	FAIR
POINT SAL	YES	MORE THAN 2X	INCREASING	FAIR
POINT STEELE	NO	N/A	N/A	GOOD
POINT DIVIDE	NO	N/A	STEADY	GOOD
POINT JUDITH	NO	N/A	STEADY	FAIR
POINT STUART	NO	N/A	INCREASING	FAIR
POINT BONITA	NO	N/A	STEADY	GOOD
POINT TURNER	-----UNKNOWN - NO DATA SUPPLIED-----			
POINT JACKSON	NO	N/A	STEADY	GOOD
POINT HANNON	NO	N/A	STEADY	FAIR
POINT BARROW	NO	N/A	STEADY	FAIR
POINT HEYER	YES	MORE THAN 2X	DECLINING	FAIR
POINT LEDGE	NO	N/A	STEADY	FAIR
POINT BARNES	NO	N/A	STEADY	GOOD
POINT CAMDEN	YES	< 50%	STEADY	GOOD
POINT HOBART	NO	N/A	STEADY	GOOD
POINT HARRIS	YES	50-100%	STEADY	FAIR
POINT DORAN	NO	N/A	STEADY	FAIR
POINT ARENA	N/A	N/A	STEADY	FAIR
POINT HIGHLAND	-----NO RESPONSE-----			
POINT HURON	UNKNOWN	N/A	UNKNOWN	POOR
POINT CHARLES	NO	N/A	STEADY	FAIR
POINT WARDE	-----NO RESPONSE-----			
POINT HOPE	NO	N/A	STEADY	GOOD
POINT LOBOS	YES	UNKNOWN	STEADY	GOOD
POINT ESTERO	-----NO RESPONSE-----			
POINT SPENCER	N/A	N/A	STEADY	FAIR
POINT EVANS	NO	N/A	STEADY	FAIR
POINT BENNETT	YES	50-100%	DECLINING	POOR
POINT COUNTESS	YES	< 50%	STEADY	GOOD
POINT GLASS	YES	< 50%	STEADY	GOOD
POINT RICHMOND	YES	50-100%	DECLINING	GOOD

APPENDIX C

<u>CLASS/ NAME VESSEL</u>	<u>CARTRIDGE RATE HIGHER DURING FIRST 3 MONTHS OF OPERATION</u>	<u>IF YES, PERCENT HIGHER</u>	<u>CURRENT USAGE RATE</u>	<u>DATA ACCURACY EVALUATION</u>
<u>WLR 75 FT</u>				
CHEYENNE	NO	N/A	DECLINING	GOOD
<u>WLR 65 FT</u>				
OBION	YES	< 50%	STEADY	FAIR
SANGAMON	YES	50-100%	DECLINING	FAIR
<u>WLIC 75 FT</u>				
HAMMER	NO	N/A	STEADY	FAIR
SLEDGE	-----	NO RESPONSE	-----	-----
CLAMP	-----	NO RESPONSE	-----	-----
WEDGE	YES	50-100%	STEADY	FAIR
MALLET	-----	NO OPERATING HOURS	-----	-----
HATCHET	-----	NO RESPONSE	-----	-----
<u>WYTL 65 FT</u>				
CHOCK	NO	N/A	DECLINING	GOOD
CAPSTAN	N/A	N/A	N/A	POOR

APPENDIX D

CARTRIDGE USE DATA FOR
INDIVIDUAL VESSELS

APPENDIX D - CARTRIDGE USE DATA FOR INDIVIDUAL VESSELS

CLASS/NAME OF VESSEL	TOTAL NO. CARTRIDGE EXPENDED	TOTAL CARTRIDGE COST	AVERAGE COST PER CARTRIDGE	SYSTEM OPERATING HOURS	CARTRIDGE COST PER OPER HOUR	ESTIMATE OF GALLONS PROCESSED	CARTRIDGE LIFESPAN IN HOURS	CARTRIDGE LIFESPAN IN GALLONS	COST/GAL PROCESSED (CENTS)
<u>WHEC 378 FT</u>									
HAMILTON	115	3007.50	26.15	150.0	20.05	720,000	1.30	6,261	0.4177
CHASE	130	3435.00	26.42	168.0	20.45	806,400	1.29	6,203	0.4260
SHERMAN	40	1020.00	25.50	70.0	14.57	336,000	1.75	8,400	0.3336
GALLATIN	30	795.00	26.50	50.0	15.90	240,000	1.67	8,000	0.3313
MORGANTHAU	99	1880.90	19.00	300.0	6.27	1,440,000	3.03	14,545	0.1306
MIDGETT									
RUSH	125	3112.00	24.90	80.0	38.90	384,000	0.64	3,073	0.8104
<u>WMEC 210 FT</u>									
DILIGENCE	120	2068.00	17.23	600.0	3.45	2,880,000	5.00	24,000	0.0718
DECISIVE	40	1020.00	25.50	123.4	8.27	593,320	3.09	14,833	0.1719
COURAGEOUS	20	510.00	25.50	35.0	14.57	168,000	1.75	8,400	0.3036
STEADFAST	30	795.00	26.50	100.0	7.95	480,000	3.33	16,000	0.1656
VALIANT	40	1020.00	25.50	47.5	21.47	228,000	1.19	5,700	0.4474
VENTUROUS									
RESOLUTE									
ALERT									
			NOT INSTALLED						

APPENDIX D

CLASS/NAME OF VESSEL	TOTAL NO. CARTRIDGE EXPENDED	TOTAL CARTRIDGE COST	AVERAGE COST PER CARTRIDGE	SYSTEM OPERATING HOURS	CARTRIDGE COST PER OPER HOUR	ESTIMATE OF GALLONS PROCESSED	CARTRIDGE LIFESPAN IN HOURS	CARTRIDGE LIFESPAN IN GALLONS	COST/GAL PROCESSED (CENTS)
WAGB 310 FT									
GLACIER	75	1574.50	20.99	100.0	15.75	480,000	1.33	6,400	0.3280
WAGB 269 FT									
NORTHWIND	25	652.50	26.10	12.0	54.38	57,600	0.48	2,304	1.1328
WESTWIND									
WMEC 205 FT									
CHILULA									
WLB 180 FT									
BUTTONWOOD	38	493.50	12.99	35.0	14.10	16,800	0.92	442	2.9375
IRONWOOD	12	153.30	12.78	200.0	0.77	96,000	16.67	8,000	0.1597
MARIPOSA	28	389.90	13.93	297.3	1.31	142,704	10.62	5,097	0.2732
BLACKTHORN	15	171.50	11.43	12.0	14.29	5,760	0.80	384	2.9774
SALVIA	14	186.90	13.35	20.0	9.35	9,600	1.43	686	1.9469
BRAMBLE	22	369.60	16.80	20.0	18.50	9,600	0.91	436	3.8500
WOODRUSH	12	153.30	12.78	10.0	15.33	4,800	0.83	400	3.1938
MESQUITE	28	470.40	16.80	110.0	4.28	52,800	3.93	1,886	0.8909
SEDGE	18	254.10	14.13	100.0	2.54	48,000	5.56	2,667	0.5294

APPENDIX D

CLASS/NAME OF VESSEL	TOTAL NO. CARTRIDGE EXPENDED	TOTAL CARTRIDGE COST	AVERAGE COST PER CARTRIDGE	SYSTEM OPERATING HOURS	CARTRIDGE COST PER OPER HOUR	ESTIMATE OF GALLONS PROCESSED	CARTRIDGE LIFESPAN IN HOURS	CARTRIDGE LIFESPAN IN GALLONS	COST/GAL PROCESSED (CENTS)
WLM 175 FT FIR	14	170.80	12.20	20.0	8.54	9,600	1.43	686	1.7792
WLM 157 FT RED CEDAR	50	840.00	16.80	50.0	16.80	24,000	1.00	480	3.5000
WLM 133 FT WHITE PINE	8	102.20	12.78	65.0	1.57	31,200	8.13	3,900	0.3276
WHITE HOLLY	29	347.30	11.98	50.0	6.95	24,000	1.72	828	1.4471
WHITE HEATH	2	17.50	8.75	100.8	0.17	48,584	50.40	24,192	0.0362
WLR 114 FT FOXGLOVE	69	759.90	11.01	258.9	2.94	124,272	3.75	1,801	0.6115
WLV 128 FT PORTLAND									
WYTM 110 FT MOHICAN									

APPENDIX D

CLASS/NAME OF VESSEL	TOTAL NO. CARTRIDGE EXPENDED	TOTAL CARTRIDGE COST	AVERAGE COST PER CARTRIDGE	SYSTEM OPERATING HOURS	CARTRIDGE COST PER OPER HOUR	ESTIMATE OF GALLONS PROCESSED	CARTRIDGE LIFESPAN IN HOURS	CARTRIDGE LIFESPAN IN GALLONS	COST/GAL PROCESSED (CENTS)
<u>WLI 100 FT</u>									
COSMOS	4	67.20	16.80	20.0	3.36	4,800	5.00	1,200	1.4000
BUCKTHORN				N O T	I N S T A L L E D				
<u>WPB 95 FT</u>									
CAPE CARTER	6	100.80	16.80	20.0	5.04	4,800	3.33	800	2.1000
CAPE WASH	8	109.80	13.73	90.0	1.22	21,600	11.25	2,700	0.5083
CAPE SMALL	3	50.40	16.80	50.0	1.01	12,000	16.67	4,000	0.4200
CAPE FOX									
CAPE KNOX	6	100.80	16.80	22.0	4.58	5,280	3.67	880	1.9091
CAPE NEWAGEN	24	306.60	12.78	30.0	10.22	7,200	1.25	300	4.2583
CAPE JELLISON									
CAPE HORN									
CAPE YORK	6	75.00	12.50	6.0	12.50	1,440	1.00	240	2083
CAPE CORWIN	30	391.30	13.04	65.0	6.02	15,600	2.17	52	5083
CAPE CROSS	2	33.60	16.80	7.0	4.80	1,680	3.50	84	2.0000
CAPE GEORGE	6	100.80	16.80	180.0	0.56	43,200	30.00	7,200	0.2333
CAPE FAIRWEATHER				N O T	I N S T A L L E D				
CAPE MORGAN	10	168.00	16.80	60.0	2.80	14,400	6.00	1,440	1.1667

CLASS/NAME OF VESSEL	TOTAL NO. CARTRIDGE EXPENDED	TOTAL CARTRIDGE COST	AVERAGE COST PER CARTRIDGE	SYSTEM OPERATING HOURS	CARTRIDGE COST PER OPER HOUR	ESTIMATE OF GALLONS PROCESSED	CARTRIDGE LIFESPAN IN HOURS	CARTRIDGE LIFESPAN IN GALLONS	COST/GAL PROCESSED (CENTS)
<u>WPB 95 FT (CONTD)</u>									
CAPE SHOALWATER	12	137.40	11.45	48.0	2.86	11,520	4.00	960	1.1927
CAPE ROMAIN	35	877.50	25.07	17.5	50.14	4,200	0.50	120	20.8929
CAPE CORAL	12	201.60	16.80	80.0	2.52	19,200	6.67	1,600	1.0500
<u>WPB 82 FT</u>									
POINT THATCHER	4	67.20	16.80	250.0	0.27	60,000	62.50	15,000	0.1120
POINT VERDE	12	148.10	12.34	80.0	1.85	19,200	6.67	1,600	0.7714
POINT WELLS	--	-----	-----	2.0	-----	480	-----	-----	-----
POINT BROWN	360	4536.00	12.60	150.0	30.24	36,000	0.42	100	12.6000
POINT ROBERTS	4	67.10	16.80	10.0	6.72	2,400	2.50	600	2.8000
POINT WHITEHORN									
POINT LOOKOUT									
POINT NOWELL	4	67.20	16.80	150.0	0.45	36,000	37.50	9,000	0.1867
POINT SAL	10	168.00	16.80	125.0	1.34	30,000	12.50	3,000	0.5600
POINT STEELE	2	33.60	16.80	2.0	16.80	480	1.00	240	7.0000
POINT DIVIDE	17	253.05	14.89	300.0	0.84	72,000	17.65	4,235	0.3515
POINT JUDITH	4	67.20	16.80	138.0	0.49	33,120	34.50	8,280	0.2029
POINT STUART	10	126.00	12.60	290.0	0.43	69,600	29.00	6,960	0.1810

APPENDIX D

<u>CLASS/NAME OF VESSEL</u>	<u>TOTAL NO. CARTRIDGE EXPENDED</u>	<u>TOTAL CARTRIDGE COST</u>	<u>AVERAGE COST PER CARTRIDGE</u>	<u>SYSTEM OPERATING HOURS</u>	<u>CARTRIDGE COST PER OPER HOUR</u>	<u>ESTIMATE OF GALLONS PROCESSED</u>	<u>CARTRIDGE LIFESPAN IN HOURS</u>	<u>CARTRIDGE LIFESPAN IN GALLONS</u>	<u>COST/GAL PROCESSED (CENTS)</u>
<u>WPB 82 FT (CONTD)</u>									
POINT BONITA	4	67.20	16.80	30.0	2.24	7,200	7.50	1,800	0.9333
POINT TURNER	2	33.60	16.80	0.5	67.20	120	0.25	60	28.0000
POINT JACKSON	2	33.60	16.80	25.0	1.34	6,000	12.50	3,000	0.5600
POINT HANNON	3	50.40	16.80	6.0	8.40	1,440	2.00	480	3.5000
POINT BARROW	4	67.20	16.80	12.0	5.60	2,880	3.00	720	2.3333
POINT HEYER	6	68.70	11.45	9.0	7.63	2,160	1.50	360	3.1806
POINT LEDGE	10	114.48	11.45	10.0	11.45	2,400	1.00	240	4.7700
POINT BARNES	6	68.70	11.45	48.0	1.43	11,520	8.00	1,920	0.5964
POINT CAMDEN	6	100.80	16.80	50.0	2.02	12,000	8.33	2,000	0.8400
POINT HOBART	2	33.60	16.80	2.0	16.80	480	1.00	240	7.0000
POINT HARRIS	4	67.20	16.80	18.0	3.73	4,320	4.50	1,080	1.5556
POINT DORAN	6	68.70	11.45	125.0	0.55	30,000	20.83	5,000	0.2290
POINT ARENA	1	16.80	16.80	3.5	4.80	840	3.50	840	2.0000
POINT HIGHLAND									
POINT HURON	--	-----	-----	1.0	-----	240	-----	-----	-----
POINT CHARLES	4	67.20	16.80	43.0	1.56	10,320	10.75	2,580	0.6512
POINT WARDE									

APPENDIX D

<u>CLASS/NAME OF VESSEL</u>	<u>TOTAL NO. CARTRIDGE EXPENDED</u>	<u>TOTAL CARTRIDGE COST</u>	<u>AVERAGE COST PER CARTRIDGE</u>	<u>SYSTEM OPERATING HOURS</u>	<u>CARTRIDGE COST PER OPER HOUR</u>	<u>ESTIMATE OF GALLONS PROCESSED</u>	<u>CARTRIDGE LIFESPAN IN HOURS</u>	<u>CARTRIDGE LIFESPAN IN GALLONS</u>	<u>COST/GAL PROCESSED (CENTS)</u>
<u>WPB 82 FT (CONTD)</u>									
POINT HOPE	8	102.36	12.79	3.5	29.23	840	0.44	105	12.1786
POINT LOBOS	8	134.40	16.80	160.0	0.84	38,400	20.00	4,800	0.3500
POINT ESTERO									
POINT SPENCER	2	33.60	16.80	6.0	5.60	1,440	3.00	720	2.3333
POINT EVANS	6	100.80	16.80	50.0	2.02	12,000	8.33	2,000	0.8400
POINT BENNETT	6	68.70	11.45	30.0	2.29	7,200	5.00	1,200	0.9542
POINT COUNTESS	8	91.60	11.45	100.0	0.92	24,000	12.50	3,000	0.3817
POINT GLASS	4	45.80	11.45	30.0	1.53	7,200	7.50	1,800	0.6361
POINT RICHMOND	4	45.80	11.45	40.0	1.15	9,600	10.00	2,400	0.4771
<u>WLR 75 FT</u>									
CHEYENNE	4	45.80	11.45	5.0	9.16	1,200	1.25	300	3.8167
<u>WLR 65 FT</u>									
OBION	6	100.80	16.80	5.0	20.16	1,200	0.83	200	8.4000
SANGAMON	3	50.40	16.80	10.0	5.04	2,400	3.33	800	2.1000
<u>WLIC 75 FT</u>									
HAMMER	6	100.80	16.80	350.0	0.29	84,000	58.33	14,000	0.1200

APPENDIX D

CLASS/NAME OF VESSEL	TOTAL NO. CARTRIDGE EXPENDED	TOTAL CARTRIDGE COST	AVERAGE COST PER CARTRIDGE	SYSTEM OPERATING HOURS	CARTRIDGE COST PER OPER HOUR	ESTIMATE OF GALLONS PROCESSED	CARTRIDGE LIFESPAN IN HOURS	CARTRIDGE LIFESPAN IN GALLONS	COST/GAL PROCESSED (CENTS)
WLIC 75 FT (CONT)									
SLEDGE									
CLAMP									
WEDGE	10	125.20	12.52	50.0	2.50	12,000	5.00	1,200	1.0433
MALLET	---	---	---	NO DATA SUPPLIED	---	---	---	---	---
HATCHET									
WYTL 65 FT									
CHOCK	--	---	---	10.0	---	2,400	---	---	---
CAPSTAN	2	33.60	5.60	6.0	16.80	1,440	3.60	720	2.3233

APPENDIX E

GEOGRAPHICAL SURVEY ANALYSIS
(VESSEL DISTRIBUTION AND COST
ANALYSIS TOTALS BY REGIONS)

APPENDIX E - GEOGRAPHICAL SURVEY ANALYSIS (VESSEL DISTRIBUTION AND COST ANALYSIS BY REGIONS)

REGION 1 - USCG DISTRICTS 2 and 9

VESSELS: MARIPOSA, BRAMBLE, WOODRUSH, MESQUITE, FOXGLOVE, CHEYENNE, OBION, SANGAMON (8)

CARTRIDGE COST: \$2,340.10

TOTAL GALLONS: 338,976

COST/GAL: 0.6903 Cents

REGION 2 - USCG DISTRICTS 1, 3 and 5

VESSELS: HAMILTION, CHASE, SHERMAN, GALLATIN, MORGANTHAU, NORTHWIND, DECISIVE, RED CEDAR, WHITE PINE, WHITE HEATH, CAPE CROSS, CAPE GEORGE, POINT BROWN, POINT STEELE, POINT BONITA, POINT TURNER, POINT JACKSON, POINT HANNON, POINT ARENA, CAPSTAN (20)

CARTRIDGE COST: \$17,709.80

TOTAL GALLONS: 4,398,424

COST/GAL: 0.4026 Cents

REGION 3 - USCG DISTRICT 7 and 8

VESSELS: DILIGENCE, COURAGEOUS, STEADFAST, VALIANT, BLACKTHORN, SALVIA, WHITE HOLLY, COSMOS, CAPE KNOX, CAPE YORK, CAPE MORGAN, CAPE SHOALWATER, POINT THATCHER, POINT ROBERTS, POINT NOWELL, POINT SAL, POINT BARNES, POINT CHARLES, POINT HOPE, POINT LOBOS, POINT SPENCER, HAMMER, WEDGE (23)

CARTRIDGE COST: \$6,648.90

TOTAL GALLONS: 4,119,720

COST/GAL: 0.1614 Cents

APPENDIX E

REGION 4 - USCG DISTRICTS 13 and 17

VESSELS: IRONWOOD, SEDGE, FIR, CAPE ROMAIN, CAPE CORAL,
POINT VERDE, POINT DORAN, POINT BENNETT, POINT
COUNTESS, POINT GLASS, POINT RICHMOND (11)

CARTRIDGE COST: \$2,126.00

TOTAL GALLONS: 274,200

COST/GAL: 0.7753 Cents

REGION 5 - USCG DISTRICTS 11, 12 and 14

VESSELS: RUSH, GLACIER, BUTTONWOOD, CAPE CARTER, CAPE WASH,
CAPE SMALL, CAPE NEWAGEN, CAPE CORWIN, POINT DIVIDE,
POINT JUDITH, POINT STUART, POINT BARROW, POINT
HEYER, POINT LEDGE, POINT CAMDEN, POINT HOBART,
POINT HARRIS, POINT EVANS (18)

CARTRIDGE COST: \$7,137.93

TOTAL GALLONS: 1,152,960

COST/GAL: 0.6191 Cents

OVERALL TOTALS:

VESSELS: 80

CARTRIDGE COST: \$35,962.73

TOTAL GALLONS: 10,283,280

COST/GAL; 0.3497 Cents